Nuts & Volts

Exploring Electronics And Technology For The Hobbyist And Professional

www.nutsvolts.com

January 2000 Vol. 21 No. 1

CLOSED CAPTIONS, V-CHIP, AND OTHER VBI DATA

There's more in your TV signal than just video and audio. Closed captions, V-chip information, time of day, program and network information, Internet links, and more lurk within the broadcast signal just waiting for you to pull it all out.

BUILDING A BETTER MOUSE TRAP — PART 1

Turn your mouse into a nifty input device for programming your VCR, controlling your model train layout, or other homebrew gadget.

BUILD A THROBBING HEART

SPECIAL VALENTINE'S PROJECT:

Express your enduring love this year with 28 bright red LEDs.

U.S. $4.50 CANADA $6.50

01>

7 25274 89295 2

CLONE, TEST OR REPAIR ANY HARD DRIVE

"THE MOST COMPLETE HARD DRIVE WORKSTATION WE'VE SEEN!" BOB ROSENBLOOM, DIGITAL VIDEO, INC.

DRIVE SERVICE STATION

Copy entire hard drives with ease. Drive duplicators are essential tools for dealers and system builders. Don't spend hours installing and formatting drives. Do it instantly with the Pro. Set up any SCSI or IDE drive with your original software. Connect blank drives to the Pro and presss start. You'll copy entire drives faster and more accurately than is possible on any PC. With our combination IDE and SCSI model, you can even copy data between diffferent interfaces. All models include both 2.5" and 3.5" interface adapters. The Pro also supports SCA and Wide SCSI drives.

Choose the Pro, and you'll also have an entire factory drive test and repair system for under $1000. The Pro gives you the ability to copy, reformat, repair, translate, and test any hard drive. Use the Pro to put any hard drive through its paces. A full factory final test and performance analysis is performed. Complete test and repair reports are sent to any standard printer.

The Pro will also reassign and eliminate drive defects. Here's how it works: First, a precise media analysis system scans the disk for errors. Defects are mapped out, and effectively "erased." The error correcting system then "trains" the drive to permanently avoid defective areas. Data is stored only on the safe areas of the disk. Capacity is reduced by an insignificant amount, and the drive works flawlessly once again. Get the technology used by major repair shops and data recovery centers. The Pro repairs all disk defects caused by normal wear. Drives with mechanical damage may not be repairable.

BUY MANUFACTURER DIRECT: $995

408 330-5525

CORPORATE SYSTEMS CENTER
3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.DRIVEDUPLICATORS.COM

Call today for high volume multi-drive copiers and CD Duplicators
Sold and intended for backup purposes only. Copyright laws must be observed.

Write in 58 on Reader Service Card.

HSC Electronic Supply

Serving Silicon Valley since 1964!

..brings you a potpourri of high-tech goodies for the techno-tinkerer!
For thirty years we have been your source for Silicon Valley exotica!

Price Breakthrough on Variable Transformers!

You say you've wanted one of these in the past, but the price kept you away? Now you can afford a brand-new variable AC supply for your work-bench! All have enclosed cases, knob and dial.

- Model AICVR-500W, 120 VAC input
- 0 - 120 VAC ouput, 500 watts
- Measures 5" dia., 6" tall
- Features meter, binding post terminals for input, output
- New in box, made in China

HSC#80474 **$50.00**

- Model AEEC-1090VR, 120 VAC 60 Hz input
- 0 - 120 VAC output, 1 KVA
- Measures 6.5" dia., 8" tall
- Features meter, illuminated switch, line cord, fuse
- New in box, made in China

HSC#80481 **$85.00**

- Model AEEC-2090VR, 120 VAC 60 Hz input
- 0 - 120 VAC output, 2 KVA
- Measures 8" x 10" x 8" tall
- Features meter, illuminated switch, line cord, fuse
- New in box, made in China

HSC#80461 **$125.00**

Alcohol Breath Tester!

- Make sure your guests (or you!) are safe to drive!
- *'ROADTest'*, Model 1110R portable breath analyzer
- Measures blood alcohol concentration from 0 to 20%
- Tin Dioxide solid state sensor
- Easy to read 4-digit lighted LCD display
- 3-Way power: NiCad battery, auto cigarette lighter, or DC adapter/charger (all included)
- Extra mouthpieces included, brand new boxed unit.
- 90-day warranty

HSC#80508 **$89.00**

Notebook Disk Drive Deal!

ock-bottom prices on your choice of diminutive disk drives om Seagate...freshly factory refurbished, guaranteed to erform good as new!

- Seagate ST9550AG 2.5" hard disk drive
- 455.3 MB, 942 cyl., 16 heads, 59 sectors
- Measures only 2.75" x 4" x .75"
- Standard 47-pin 2.5" IDE connector
- Factory refurbished, 90 day warranty

ISC# 18133 **$29.50**

- Seagate ST9385AG 2.5" hard disk drive
- 341.4 MB, 934 cyl., 14 heads, 51 sectors

ISC# 18136 **$19.95**

- Seagate ST9235AG 2.5" hard disk drive
- 209 MB

ISC# 18133 **$14.95**

- Mounting bracket to adapt 2.5" drives to 3.5" form-factor
- Includes adapter PC board to standard IDE ribbon cable connnector and power supply plug

ISC# 18134 **$4.95**

Game Player's Delight!

- New! 5-in-one multimedia card features a video accelerator and sound card with game controller!
- PCI bus card features 3-D accelerator, with wavetable sound, Sega game controller port (with controller!), SVGA Windows accelerator and MPEG video player
- Provides one IBM game port and two Sega game ports
- Extended graphic modes up to 1600 x 1200 x 256 colors, 1152 x 864 x 64K colors, or 800 x 600 x 1 Billion colors
- Supports up to 120 Hz vertical refresh rate
- On chip accelerates all of the Windows 95 Direct X modes (Direct Draw, Direct Sound, Direct Input, Direct Video)
- Plays Windows 95 Direct 3D games
- Full-motion digital video and Software MPEG playback
- Provides wavetable from 1MB to 6MB, depending on system memory
- Hardware wavetable synthesis delivers up to 32 voices of 16-bit quality audio sampled at 50 KHz
- Includes cable adapter bracket, Sega Saturn game pad
- Two CD-ROM's with PC versions of Virtua Fighter, Panzer Dragoon games, plus installation CD-ROM
- New in box, 90-day warranty

HSC# 18111 **$29.50**

ATX Infrastructure!

- "Sparkle Power" 235W fan-cooled ATX supply
- Perfect for ATX Tower & Mid-Tower Cases
- Input: 100-120VAC ~ 7A/200-240V ~ 4A, 50-60Hz
- Output: 3.3VDC/14A, +5Vsb/0.8A, +5VDC/22A, -5VDC/0.3A, +12VDC/8A, -12VDC/0.8A
- Power-Good signal line, Noise suppression
- Standard ATX-motherboard, disk drive power connectors
- Measures 3.375" x 5.5" x 6" (Standard ATX Form-Factor)
- New, 90-day warranty

HSC#18108 **$19.95**

- Need a case for your new ATX motherboard?
- ATX-style mid-tower cabinet, fashion-curved front
- ATX power supply <u>included</u>
- Three 5.25" and two 3.5" front bays
- 16.5" H x 8.25" W x 16.5" D
- Brand new in box, 90-day warranty

HSC# 80459 **New, lower price!** **$39.95**

ISA to SCSI Adapter

- Adaptech model AVA-1505AI -- Brand Name Quality!
- Single, complete PC connection
- For *single* non-bootable SCSI2 peripheral
- New, OEM pack, with install diskette & manual

ISC#17995

$17.50

Special! ...w/DB25 adapter & cable **$19.95**

Multimeter Specials!

- Model #AEEC-1890 DMM with extras!
- 3 1/2 Digit LCD
- Adjustable Flip-Up display for the easiest viewing ever!
- 0.5% basic accuracy, dual-slope integration A/D converter
- Measures AC/DC volts, Ohms, Current, Capacitance & hFE
- Ranges:
  1000VDC, 700VrmsAC, 200 ohm - 200 Megohm
  20 mA - 20A, 2nF - 20 uF, NPN/PNP hFE.
- Separate jacks for capacitors and transistors
- 'HOLD' function to capture measured peaks
- Yellow soft rubber cradle protects meter and prevents skids
- Brand New! - With Test Leads
- Compare at prices of $70, $80 and up!

HSC#80504 **$39.95**

- Inexpensive Digital Multimeter is packed with features!
- 0.5% Basic Accuracy, 19 scales, battery included!
- Ohms, Volts DC & AC, Milliamps DC & AC, 10 Amps DC
- Diode Tester, Transistor checker
- With test leads, instructions
- New, 30 day warranty

HSC#80370 **$14.95**

PCMCIA 28.8 Modem!

- Texas Instruments 'Livegear' 28.8K fax/voice/modem
- Full setup includes modem, driver diskette, cable, telco/coupler and Cheyenne "Bitware" communications suite
- V.34 data (28.8 K bps), V.17 fax (14.4K bps)
- V.42 Error Correction, V.42bis Data Compression
- Will work as speakerphone and answering device with TI Extensa 600, 650 0r 900 notebook computers!
- Voice operation (telephone) requires your notebook to have sound with speakers/microphone (or headset)
- Windows 95, Windows for Workgroups v3.11 drivers
- New -- 90 day warranty.

HSC# 18135 **$27.50**

Laptop Carrying Cases

- Measures 12.5" x 10" x 2" (inside dimensions)
- Velcro-sealed outer pouch, padded shoulder strap with heavy-duty swivel hooks, zipper closure.
- Handsome black vinyl "leather-grain" exterior
- Cushiony plush interior protects your laptop's case
- Quantity discounts available

HSC#17662 **$17.50**

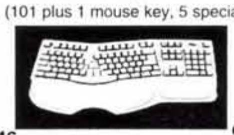
Sidewinder Slashed!

- Microsoft "Sidewinder" game controller ... Wow!
- New,OEM package, high quality for fast action!
- Download drivers from Microsoft.com
- Eight programmable action buttons, two fire buttons

ISC#80486 **$17.50**

Ergonomic Keyboard!

- Mouse Systems "Contour 107" comfort keyboard!
- New in box with AT/PS2 adapter
- 107 keys, (101 plus 1 mouse key, 5 special function)



HSC# 18046 **$19.95**

Rechargeable Battery Buy!

mazing power in a small package! Nickel-Metal Hydride (Ni-MH) batteries have the capacity of Nicads without the "memory" effect. These are factory-new, not pulls!

Toshiba 8TH-F5-F1-AIR, 9.6VDC at 600 mAH, measures 4.5" x 1.875" x .25" thick (8 cells in series)
Has a thermal circuit breaker for over-current protection

SC#17871 <u>Now, lower price!</u> **$9.95**

External SCSI Drive Case!

- Small vertical-format case for 3.5" drives, brand new!
- 3.75" x 5.5" x 9.75" overall size
- 50-pin SCSI connectors
- SCSI ID switch, termination switch
- Universal input 40W Power supply
- Fan-cooled, uses standard IEC Power cord (not included)

HSC# 18075 **$24.95**

PCI-Bus 56K Modem!

- Genica PCI-Bus 56K Modem at unheard-of price!
- Data, FAX, voice, full V.90 compatibility
- Voice from handset
- Windows 95/98 or NT only (Not Win 3.1 compatible)
- Uses latest Lucent chipset, comes with Lucent drivers
- New retail box, with expanded application software on CD
- 90-Day Warranty

HSC# 17532 **New! Lower Price!** **$29.95**

Halted specialties co. **HSC Electronic Supply**

oll Free (Orders Only) 1-800-4 HALTED (1-800-442-5833)
nternet World Wide Web: http://www.halted.com
500 Ryder St., Santa Clara, CA 95051 (408) 732-1573
837 Amber Ln., Sacramento, CA 95841 (916) 338-2545
681 Redwood Dr., Rohnert Park, CA 94928 (707) 585-7344

-or- FAX your orders to: (408) 732-6428

Visit HSC's Website!

- Pay us a virtual visit on the World Wide Web!
- Simply point your browser to *http://www.halted.com*
- Site is constantly being revised, please visit often!
- Or, you can email your order to *hscmail@halted.com*

HSC Catalog online!

- That's right, get HSC's catalog on the World-Wide Web!
- Simply go to www.halted.com and follow the big red link.
- Adobe .PDF files are available for download and viewing.
- Or drop on by and pick one up...we'd love to see you!

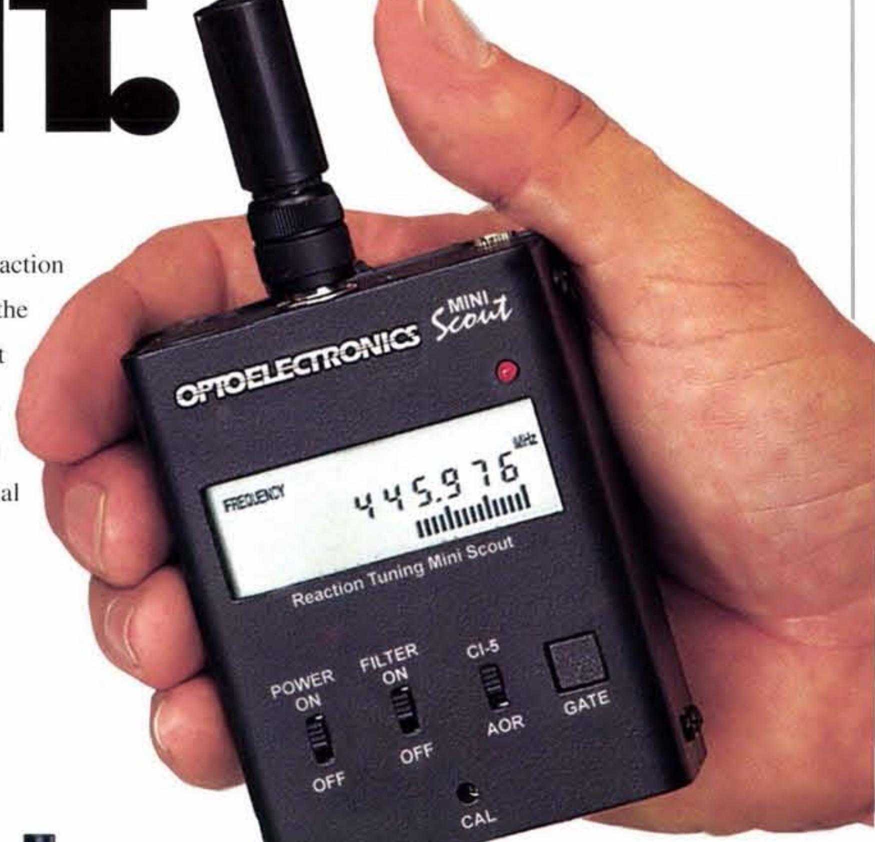
Terms: Some quantities limited; all items subject to prior sale. **Minimum order: $10.00 plus shipping.** Orders under $20.00 subject to $2.00 handling fee, <u>in addition to shipping</u>. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surface (no P.O. Boxes) unless otherwise specified, in which case prevailing carrier rate <u>plus</u> $5.00 handling fee applies. Prepaid orders that don't include shipping charges will be shipped freight COD. There is a $5.00 UPS charge added to shipping charges for COD shipments. If you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.

Write in 64 on Reader Service Card.

NEW

CATCH IT. HOLD IT. TUNE IT.

Tuning your receiver will never be easier. Introducing the all new Mini Scout Reaction Tuner. With a .001 second measurement time, the Mini Scout will not miss even the briefest of transmissions. While locking onto a frequency from up to 200 feet away (5w UHF), the Mini Scout automatically tunes the receiver* to the action using its patented Reaction Tune capability. No manual tuning necessary.



***Compatible Receivers:**

ICOM
7000, 7100, 8500, 9000, R10
AOR
8000, 8000B, 8200
Optoelectronics
Optocom, R11
Radio Shack
Pro2005/6 with OS456/Lite
Pro 2035/42 with OS535

No modifications necessary. Interface cables required.

Patent No. 5,471,402

Mini Scout Reaction Tuner

$249

Specifications	Scout	Mini Scout
10MHz - 1.4GHz	•	•
Reaction Tune	•	•
LCD Display	•	•
<3mV Sensitivity	•	•
Signal Strength Bargraph	•	•
Filter Mode	•	•
Capture Mode	•	
Backlight	•	
Beeper	•	
Vibrator	•	
400 Memories	•	
255 Hits Counter	•	

Patent No. 5,471,402

AR8200 Not Included

Scout Frequency Recorder Reaction Tuner

$349

Place your Order anytime at the Optoelectronics Cyber Store www.optoelectronics.com

SPECIAL
DB32 & CC30 $29

Are FM Broadcast signals a Problem?
Knock them out with the N100 Notch Filter. Blocks 88 - 108MHz, Connect between antenna and Scout or Mini Scout..$99

OPTODIRECT • 800-327-5912

OPTOELECTRONICS®

5821 NE 14th Avenue • Ft. Lauderdale, FL 33334
Phone: (954)-771-2050 Fax: (954)-771-2052 E Mail: sales@optoelectronics.com
Prices and Specifications are subject to change without notice or obligation.
DB32 Antenna shown on Scout and Mini Scout sold separately. AOR, ICOM, Radio Shack are all registered trademarks

Write in 59 on Reader Service Card.

VOLUME 21 • NO. 1
JANUARY 2000

Contents

Columns

Classified Ad Index

Departments

NUTS & VOLTS MAGAZINE (ISSN 1065-2035) IS PUBLISHED MONTHLY FOR $19.00 PER YEAR BY T & L PUBLICATIONS, INC., 430 PRINCELAND COURT, CORONA, CA 92879. APPLICATION TO MAIL AT PERIODICALS POSTAGE RATES IS PENDING AT CORONA, CA AND AT ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO NUTS & VOLTS MAGAZINE, 430 PRINCELAND COURT, CORONA, CA 92879-1300.

Published Monthly By
T & L Publications, Inc.
430 Princeland Court
Corona, CA 92879-1300
(909) 371-8497
FAX (909) 371-3052

E-Mail — editor@nutsvolts.com
URL — http://www.nutsvolts.com

Subscription Order ONLY Line
1-800-783-4624

PUBLISHER
Jack Lemieux *N6ZTD*

EDITOR
Larry Lemieux *KD6UWV*

MANAGING EDITOR
Robin Lemieux *KD6UWS*

ON-THE-ROAD EXHIBIT COORDINATOR
Audrey Lemieux *N6VXW*

SUBSCRIPTIONS
Abby Madain

CLASSIFIED ADS
Natalie Sigafus

DISPLAY ADS
Mary Gamar

Copyright 2000
by
T & L Publications, Inc.
All Rights Reserved

All advertising is subject to publisher's approval. We are not responsible for mistakes, misprints, or typographical errors. Nuts & Volts Magazine assumes no responsibility for the availability or condition of advertised items or for the honesty of the advertiser. The publisher makes no claims for the legality of any item advertised in Nuts & Volts. This is the sole responsibility of the advertiser. Advertisers and their agencies agree to indemnify and protect the publisher from any and all claims, action, or expense arising from advertising placed in Nuts & Volts. Please send all subscription orders, correspondence, UPS, overnight mail, and artwork to: **430 Princeland Court, Corona, CA 92879.**

by Gordon West

COLOR IMAGING ON MOST ANY RADIO SYSTEM

Hams call it "slow scan television." Public safety officials call it "photo facsimile" when they might send a mug shot over the airwaves. The more generic term might simply be "color video imaging over radio system frequencies."

"When the Orange County (California) chapter of the American Red Cross wanted to see a still color picture of where they would stage their emergency response vehicles, it took only a half minute to send the color video image from the Costa Mesa staging site back to the Red Cross emergency operations center in Santa Ana," comments Julian Frost N3JF, a licensed ham and a communications leader for his local Red Cross unit.

"It took us 36 seconds to send a medium-resolution picture with our completely handheld equipment through our local Costa Mesa city ham repeater," adds Frost. The picture was received clear as a bell and displayed on the big EOC television at the Red Cross Chapter. Nothing more than the visual communicator converter tied into a simple ham radio handheld was all that was necessary to bring in the shot.

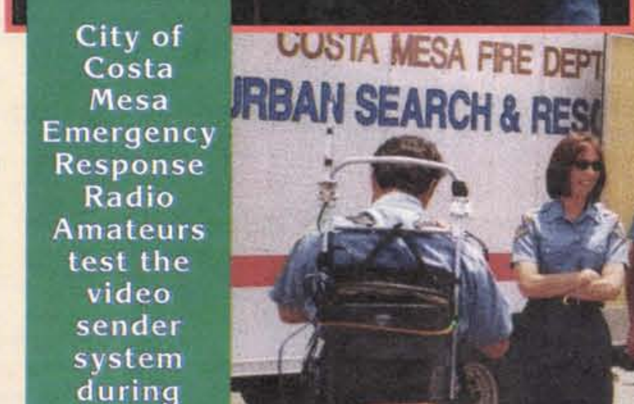
Two well-respected companies are bringing in the handheld, battery-operated visual communicators. Kenwood Corporation offers the VC-H1 interactive visual communicator, and AOR USA offers the AR-300 image picture communicator. Both sets look almost identical, but Kenwood builds in multiple slow-can television formats including Robot, AVT, Scottie, Martin, and their proprietary fast FM mode. The Kenwood fast FM mode is a little bit like ham slow-scan television Robot C36, but it can send a color picture in 17 seconds instead of 36 seconds. In the fast FM mode, the Kenwood visual communicator operates at 9600 bps which is compatible with bandwidth rules on ham VHF and UHF frequencies.

The AOR AR-300 and its AR-570 base station uses its own FM format and protocol which occupies less bandwidth but takes about 30 seconds for a standard-resolution color image, and 69 seconds for a high-resolution color image. Black-and-white imaging is also available in about half the time.

"During a recent "My Camera" demonstration with the City of Costa Mesa Disaster Preparedness Committee, city officials were amazed that this type of imaging was available at relatively low cost for their volunteer ham radio operators.

"It sounds like we aren't talking about thousands of dollars in the budget necessary for visual communications over radio, but rather only hundreds of dollars for each visual communicator set," comments one of the city disaster team members, marveling at the clarity of the color imagine sent over the ham radio repeater system.

"I could see our ham volunteers using this equipment to bring color still pictures into our city emergency operations center, and allowing everyone to see first hand a still color picture with just a little ham radio handheld transceiver coupled to this lightweight, battery-operated visual communicator."



City of Costa Mesa Emergency Response Radio Amateurs test the video sender system during a drill.

The 30-second actual radio transmission sounds like what you might hear when you pick up your FAX phone in the middle of a transmission. High and low tones, along with a rhythmical timing click, correspond to the visual image as it is scanned from top to bottom. Kenwood Corporation, best known for its amateur radio and commercial radio products, sells their visual communicator VC-H1 into the ham market because of its full capabilities to decode, as well as send out all of ham radio slow-scan television formats. This could allow the Kenwood visual communicator to work over both high frequen-

Close-up of the Visual Communicator's color LCD screen image of Gordo's ham station.

You do not necessarily need to be a licensed amateur radio operator to take advantage of the latest breed of add-on radio technology: color video imaging.

As long as you do not exceed your radio system's legal bandwidth limits, and don't cover up voice traffic on the air, almost all two-way radio networks could benefit from the transmission of still color images over the airwaves.

cies, as well as VHF and UHF with almost any type of ham radio imaging system. While you cannot select which ham radio mode you are about to receive or send, the reception of an image will automatically cue the equipment into the proper compatible picture exchange mode.

The AOR AR-300 works on its proprietary mode, and a similar video communicator can decode the picture, as well as the AOR stand-alone color image "trans view" black box, Model AR-570.

So one of the first decisions to be made for any radio operator is whether or not they need ham radio compatibility, which they would get with the Kenwood equipment, or the AOR system that can work in both ham, as well as *any* radio set-up, but only among AOR-compatible systems.

The handheld device that takes video images and transforms them into a digital signal processed stream of tones, along with its built-in receiver that digital signal processes these tones over the air, is a simple-looking handset with a detachable CCD camera mounted on the top. The monitor display is 1.8 inches diagonal, and is a thin-film-transistor, color LCD with anti-glare coating on the surface. It's swell for seeing at night, great for seeing in the dark, somewhat viewable in bright light, and totally non-viewable out in the sunlight. But this is true with any color LCD screen — they wash out in direct sunlight.

Both the Kenwood and the AOR handheld video sender/receiver systems can hold up to 10 images stored in a compressed JPEG format. This could allow you to capture 10 color video images in the field in the direct sunlight, and then take the equipment into the shade and see which ones you want to send over the airwaves. The little CCD camera on the top swivels 360 degrees and, if you really want to squeeze every bit of resolution out of the system, you could even substitute a more elaborate CCD camera system for the little one on the top.

WARNING: NEVER LET THE CAMERA SWEEP THE SUN — TO DO SO WILL PERMANENTLY BURN THE SENSITIVE CAMERA IMAGING SYSTEM, and you will forever see a bleach mark right in the middle of the shot. Always keep the camera pointing away from the sun at all times when turned on!

The visual communicator handheld equipment runs on four AA batteries, and draws about one-half amp of current when completely turned on. Needless to say, you don't turn it on until you want to either capture an image or see it or send it.

You don't need to turn it on to have it double as a speaker microphone. You order the handheld video unit with the appropriate curly mike cord that is going to plug into your particular type of handheld transceiver. Keep in mind that the radio is not built into the handheld video unit, but the video unit CAN double as a handheld speaker and microphone along with the push-to-talk.

Make sure and order the right interconnect cable that matches your particular style handheld!

The built-in microphone is an electret condenser mike, and this requires just a couple of milliamps of current to operate which is supplied by your transceiver. The speaker is 16 ohms output, and the video image is sent down the supplied curly cord to your particular style handheld

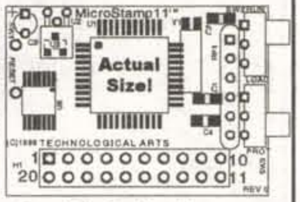
This is a close-up view of the battery-operated video sender from AOR.

Both Kenwood & AOR visual communicators run on AA batteries.

World's Smallest 68HC11 Microcontroller Module!

MicroStamp11™ NEW!

- tiny 1-inch x 1.4-inch module
- 5V regulator, 8MHz crystal
- choice of 8K or 32K EEPROM
- plugs into your breadboard like a DIP
- SCI, SPI, OC, IC, timer, interrupts, and more
- all I/O lines brought out to versatile 20-pin connector
- easy programming/code-loading with Docking Module
- 8K Starter Package #MS11SP8K......................$49*
- 32K Starter Package #MS11SP32K..................$60*
- additional modules from $34 each



Possible Applications:
- remote telemetry
- micro robotics
- smart sensors
- many more!

* Includes MicroStamp11, documentation, PC software, serial cable & Docking Module. Add $5 for shipping & handling

Technological Arts

Visa•MasterCard Discover•Amex

Phone: (416) 963-8996 Fax: (416) 963-9179

www.technologicalarts.com

SATELLITE TV - HACKERS 'BIBLE'!

The SECRETS are REVEALED!

- The principles of security
- Descrambler building blocks
- Smart cards, information wars & stupid mistakes
- Cracking codes (includes DirecTv source code)
- Installing and hooking up descramblers
- Video manipulative systems...and much more...

www.baylin.com
or... call 800-483-2423

576 pages, 6" x 8-1/2"

NEW! 5th Edition

ORDER via Internet or Send $60 plus $5 s/h to:
Baylin Publications, 1905 Mariposa, Boulder, CO 80302
MASTER,VISA & AMEX /COD orders accepted

Telephone: 303-449-4551
FAX: 303-939-8720

FREE CATALOG – Satellite TV books, videos and software

Write in 205 on Reader Service Card.

Ham Operator Byron Grams KC6YNG prepares to send a radio photo with his handheld system.

with the proper impedance match to impress it on your handheld audio circuit.

The tones are sent out on the FM carrier, or over single sideband, as analog audio tones. The portable video imaging unit measures 6-3/4" high, 2-5/8" wide, and 1-3/8" deep. A proprietary plug is inserted in the bottom of the equipment that will then terminate to the proper microphone and speaker plugs that will plug into your specific handheld equipment.

Remember — every handheld is slightly different on its external microphone and speaker output jack, so you must order the right plug for the equipment. An exception would be the Kenwood video unit which comes with the common Kenwood speaker microphone plug as part of the package.

The video output is 75 ohms, one-volt, peak-to-peak, and the built-in digital signal processor modulates the tone by the video-controlled oscillator. On the AOR unit, demodulation is accomplished by arctangent angle by DSP.

The whole handset, including batteries, weighs under two pounds; and if you are cautious about how long you leave the equipment turned on, it should play for at least a day full of color imaging.

You can also internally generate characters to give important information to any sent image. These characters include the full alphabet, and numbers 1 to 9, plus zero, and the slant bar.

The handheld video imaging device also has external jacks for six-volts input, external video output, and a comm port for use with a PC. A TX/RX lamp will illuminate when you push the send button to send an image you have captured on the screen, or any one of 10 stored images. To send an image, aim the camera, press a single button to freeze the shot and store it into memory, and then send the memorized picture over the airwaves taking about 30 seconds for the AOR equipment, and 16 seconds for the Kenwood equipment. For more detailed AOR resolution, this may be programmed ahead of time and the one-minute picture will have some outstanding resolution to be best appreciated on a large screen television.

To decode the images, AOR offers a stand-alone color image base or mobile system that can transmit and receive full color television-quality still images over your normal radio circuit, or even off of telephone and cellular lines. The AR-570 from AOR features DSP technology for clear pictures and there is absolutely no external computer required for the entire transmission or reception of the still color images. Image frame memory, telephone line interface, built-in microphone relay, computer interface, DAT/MD compatible

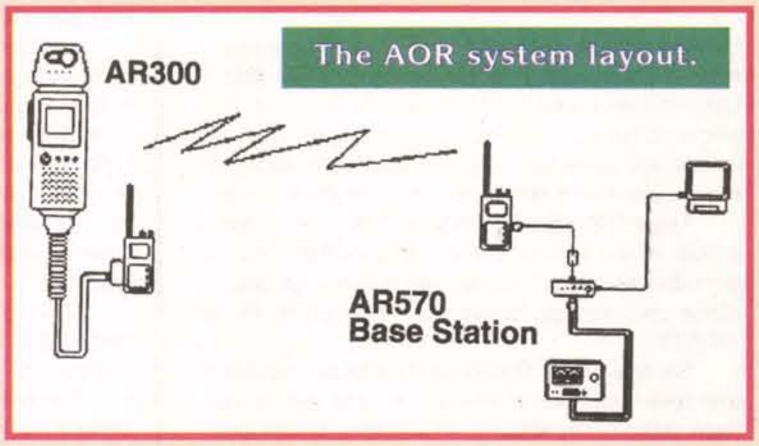
An elevated antenna allows the sending of the radio photos over simplex frequencies up to 30 miles away.

recorder jack, and the rugged metal case are some standard features of the AOR AR-570. There is even a network control unit function that could provide for full automatic dialing and reception over telephone line networks, too.

This means you could mount an unattended AOR system at a remote location, and have the received images come out over a normal telephone system to a companion AR-570 decoder.

Most interesting were the capabilities of this equipment to work off of normal radio circuits. You at first want to insure that the radio system owner and control operator are familiar with the type of modulation they are soon to hear over the airwaves. Even the ham radio operators who really knew their stuff were surprised that all of this racket was presenting wonderful color imagery at another receiving point. During our tests with the American Red Cross, as well as the

The AOR system layout.



Catch The Bus

USB Relay Module
Control 8 to 16 "form C", 1 Amp relays

USB Opto Module
8 to 32 opto-isolated Inputs and Outputs

USB Digital Module
Industry standard 50 pin interface

USB Temperature Module
Measures temperature over multiple remote sensors

J-Works, Inc
12328 Gladstone St., Unit 4
Sylmar, CA 91342
(818) 361-0787 Voice
(818) 270-2413 Fax

Visit our Web site for free information on all our products
http://www.j-works.com
E-mail sales@j-works.com

Write in 206 on Reader Service Card.

Model PTS-10
$55

LIFETIME WIRE STRIPPER, a breakthrough in wire stripping technology. Extremely fast tool will strip PVC insulation #14 to #30 AWG from solid, stranded or shielded wires. High quality strip is achieved by patented stripping element (.008" thick) which thermally cuts the insulation all the way to the conductor without nicks. Five year test, with over 2 million stripped wires, using the same element, speaks for itself. The stripper has won a —

"FIVE STAR PRODUCT OF THE MONTH"
award in DESIGNFAX magazine. Strippers for TFE, KAPTON, KYNAR, SILICONE RUBBER, etc. and rechargeable, battery powered strippers also available.

PATCO Service, Inc., 2515 Glencoe Rd., Baltimore, MD 21234
(410) 444-4010 Fax (410) 254-9566

Write in 207 on Reader Service Card.

city of Costa Mesa, we sent images over a variety of different radio systems.

Ham operators wanting to blend in with other video artists would probably choose the Kenwood equipment because of its multiple SSTV formats. But if you're building your own new video system, AOR indicates their proprietary signaling is an excellent way to go to insure commonality between agencies. In an emergency, you'd want to be able to send pictures to other agencies that may have the same AOR equipment.

Some of the uses by different agencies might be a police department that could send a mug shot to a distant officer in the field who may be holding a suspect that may match the description. Fire personnel could take a unit aloft and send down an image of the fire storm so ground personnel could better see exactly where the boundaries are. During our American Red Cross demonstrations, we would send many images showing the layout of our different stations at a mass meeting exercise, and this gave Red Cross staff members a much better idea of where everything was located when they planned to come down that night for a visit.

City employees could also shoot some pictures of new cracks in certain structures after one of our numerous Southern California earthquakes. Nothing beats the capability of seeing exactly what they are seeing.

Best of all is the capability of sending these images over a regular radio system. Just as long as the radio service is allowing 30 seconds of audio tones to come over their circuit, things should work swell. We found that all amateur radio repeaters could easily pass these tones, including those repeaters that had certain types of filters to drop out DTMF tones. And, if someone should accidentally key up for a second to disturb your 30-second transmission, all you might see is a few lines in the middle of the received photo.

But probably the biggest thing to work out ahead of time is letting everybody know on channel that you are about to tie up the frequency for 15 seconds, or 30 seconds, or maybe 60 seconds for a high-resolution image transfer. When you're sending, the frequency is dominated by the tones that are coming over your video system. When you've completed sending the picture, give your FCC call sign, and get on with business on the channel.

I would strongly suggest a copy of the Federal Communications Commission Code of Federal Regulations, CFR 47, specifically covering Part 80 marine, Part 87 air services, Part 90 land mobile radio, Part 95 personal radio, and Part 97 amateur radio services. Read carefully whether or not analog tones may or may not be superimposed on your carrier within the band limits specified in the rules. If necessary, check with your local frequency coordinator. Since this is a relatively new concept in the land mobile radio service, there may be interpretations in the law as to whether or not tones may be permitted on a channel that would normally carry only voice FM emissions.

Both Kenwood Corporation, as well as AOR promise *Nuts & Volts* readers plenty of information about their visual communicators. For Kenwood amateur radio products, log on to www.kenwood.net. Then look up their VC-H1 SSTV visual communicator.

For AOR product information, go to www.aorusa.com, and look up AR-300 and AR-570 color image facsimile systems.

AOR also indicates they would like to hear from commercial users who may have specific applications for their video radio senders. Contact Taka at AOR in Torrance, CA, at 310-787-8615, or FAX 310-787-8619.

So next time you hear some strange sounds coming over your local radio channel, or even over high-frequency marine radio or ham radio, chances are it is some form of still color photograph sending and receiving. Go to the web sites and see all that you can see with these under-$900.00, handheld, add-on visual communication devices. **NV**

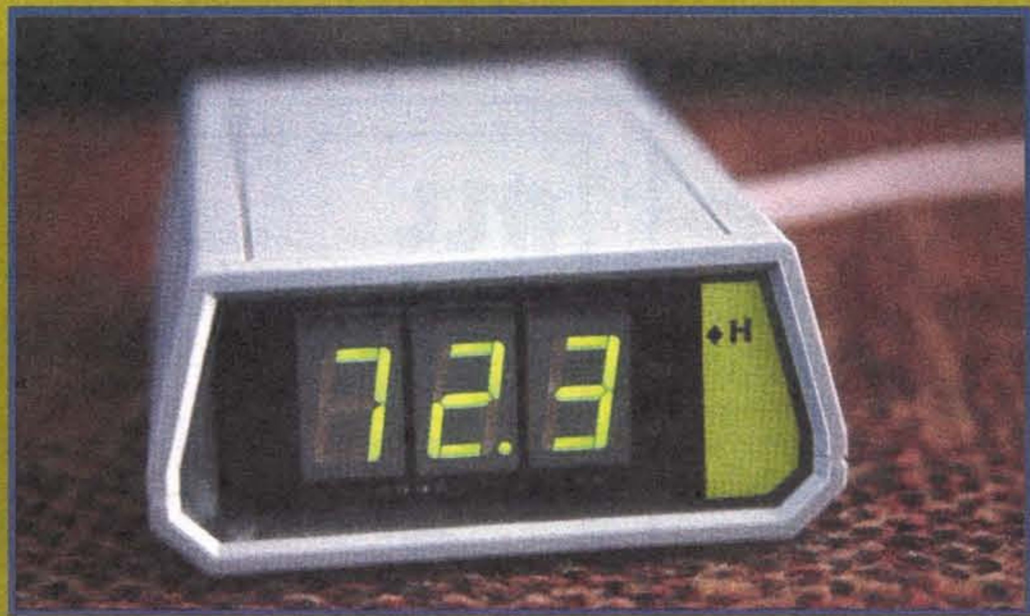
Write in 208 on Reader Service Card.

INDOOR DIGITAL HUMIDITY METER

by Richard Panosh

You can build a digital indoor humidity meter that displays the relative humidity on a green 0.56" LED display.

The display can be easily read from a distance of 20 feet and employs a Philips capacitance humidity sensor.



Indoor comfort is governed both by temperature and humidity. During the winter, the cold outdoor air contains little humidity and when it is warmed indoors, the humidity is further reduced. During the summer, air-conditioning also reduces the humidity when the air is cooled by the evaporator. A few household activities like cooking, laundry, and bathing will add moisture to the air.

The importance of the relative humidity can be very significant. A resting individual will lose approximately one quart of water ever 24 hours at a room temperature of 70°F and relative humidity of 50%. Indoor house plants will also lose water due to low humidity.

You can build a digital indoor humidity meter that displays the relative humidity on a green 0.56" LED display. The display can be easily read from a distance of 20 feet and employs a Philips capacitance humidity sensor.

Circuit Description

The schematic diagram for the humidity meter is shown in Figure 1. The circuit is powered from a 5-9VDC wall transformer. Internally, this voltage is dropped and regulated to +5V by IC1, a Maxim Max738A switching regulator (max. DC input 16 volts). The switching regulator operates at better than 85% efficiency to convert the input power. Since each segment of the LED display is operated at 15 mA for high brightness, a 0 display with six elements active will require about 90 mA total current. If a linear regulator was used, it would dissipate nearly half a watt, dropping 9V to

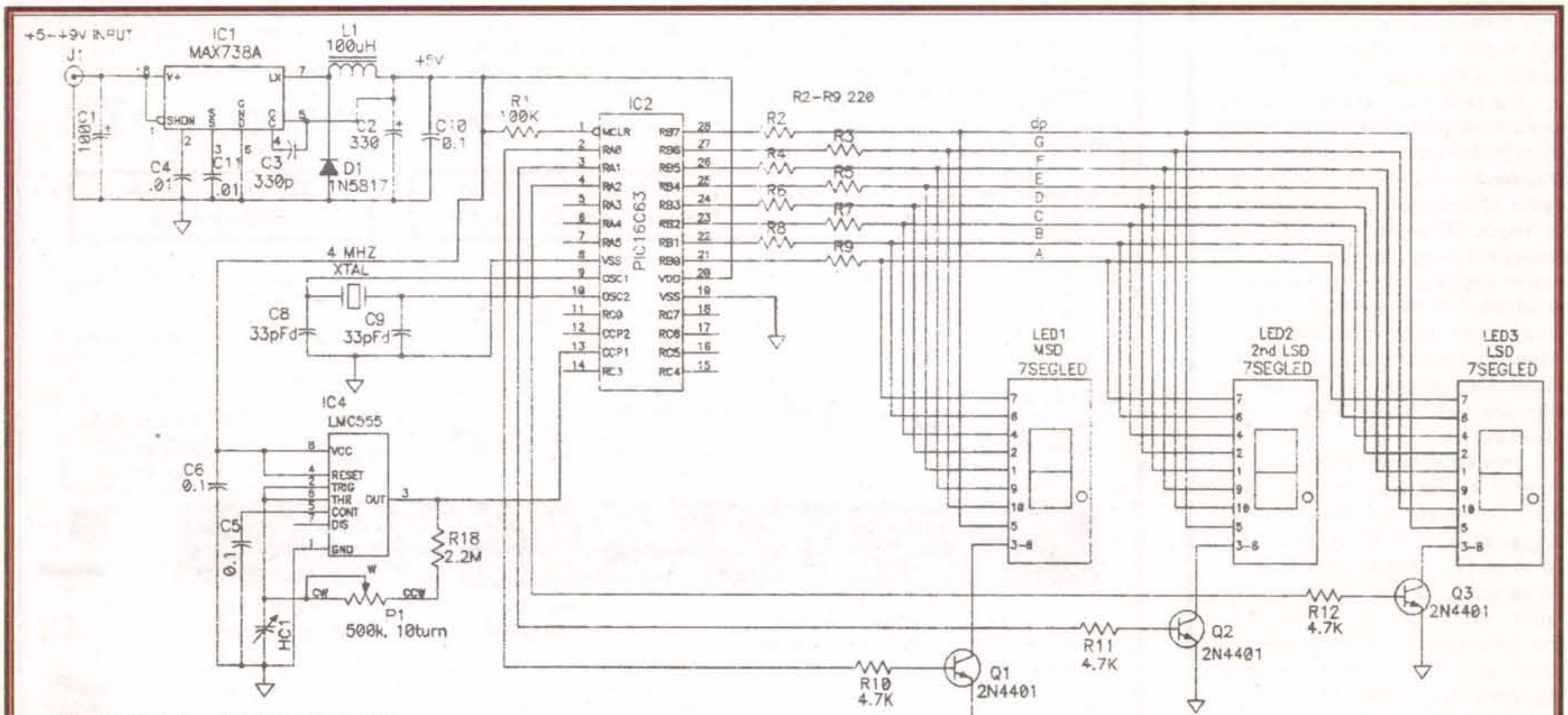
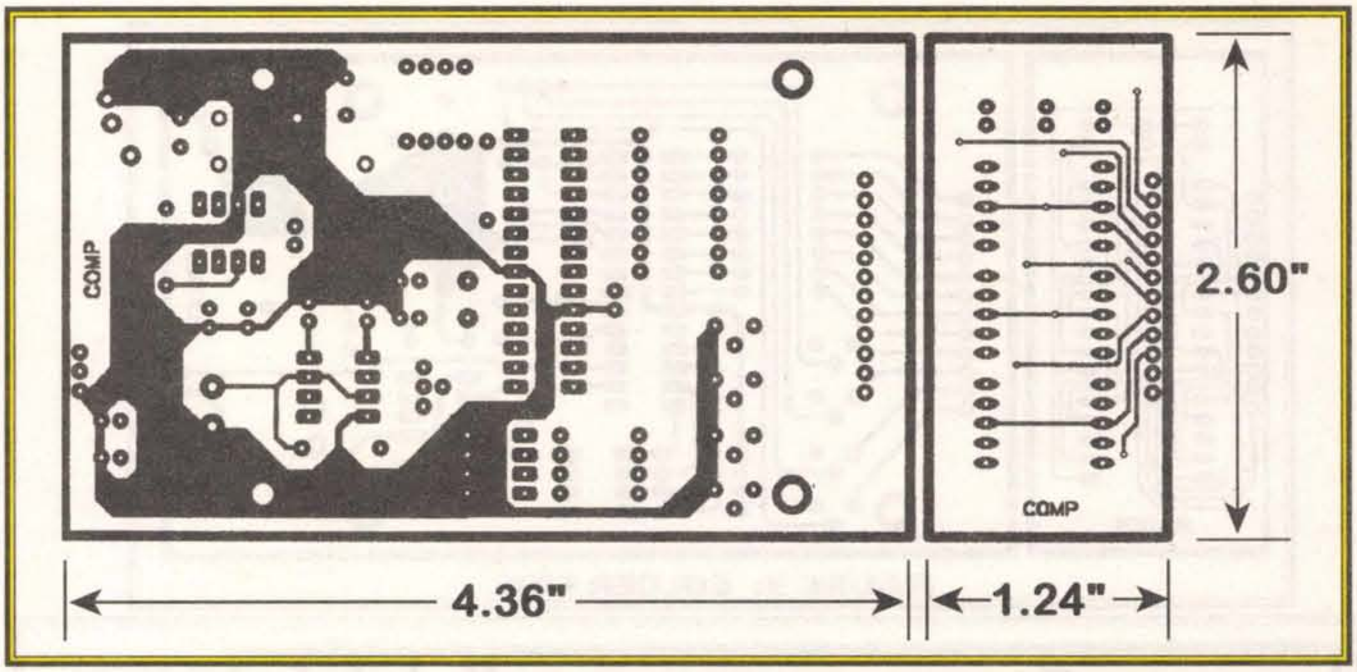


FIGURE 1: SCHEMATIC

FIGURE 2: COMPONENT SIDE

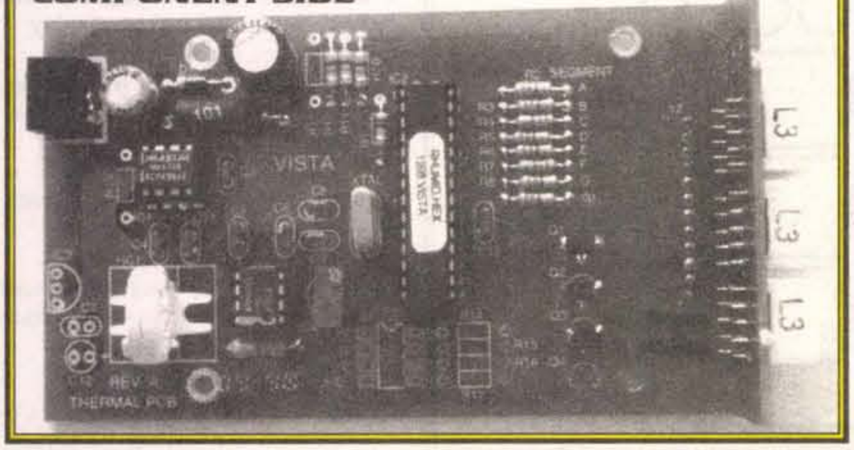


5V.

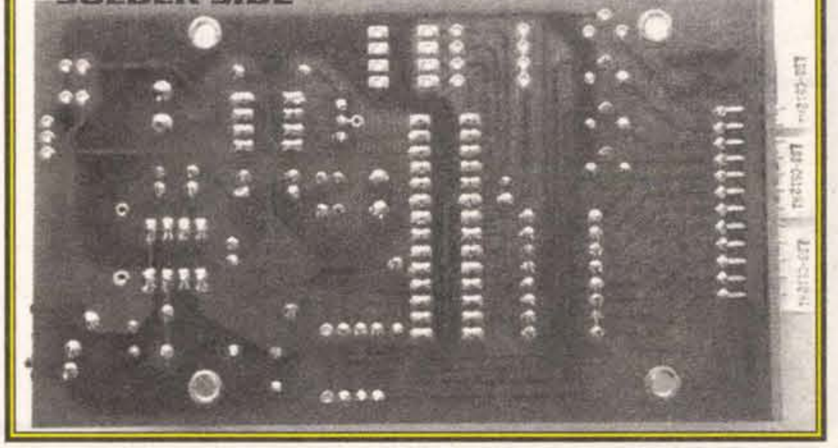
HC1 is the Philips capacitance humidity sensor. The dielectric constant of the sensor changes as a function of relative humidity. The sensor is connected with the CMOS version of the 555 timer to form an oscillator. The resulting frequency produced is a function of the relative humidity which allows a microprocessor to calculate and display the value.

The total change of capacitance over the range of humidity is only about 40 pFd and the sensor capacitance tolerance is on the order of ±15% which requires

COMPONENT SIDE



SOLDER SIDE (note header location on bottom)



Write in 127 on Reader Service Card.

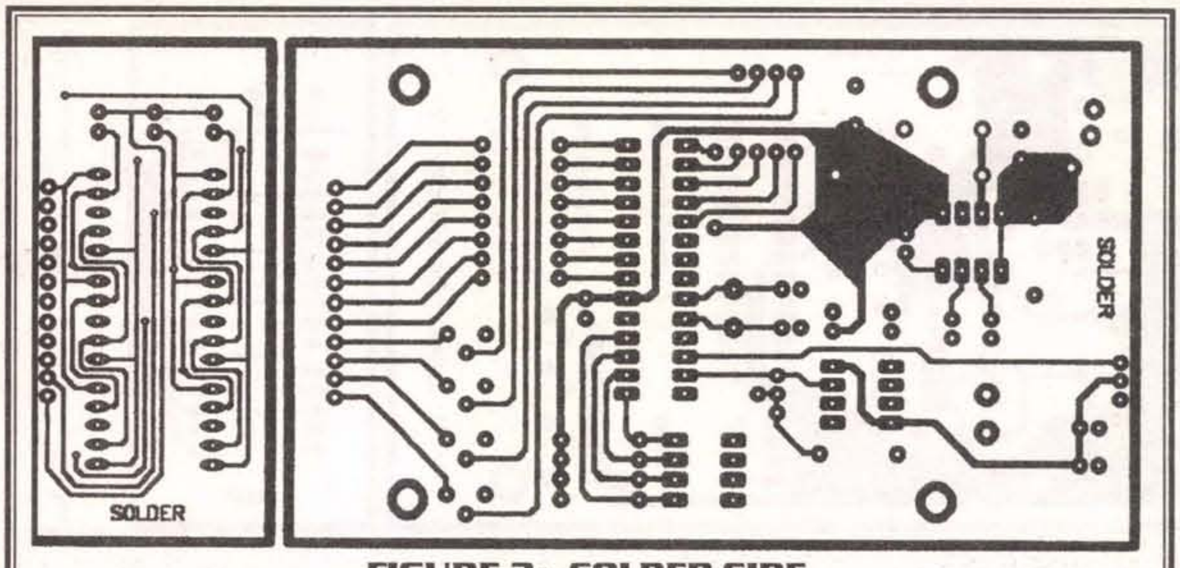


FIGURE 3: SOLDER SIDE

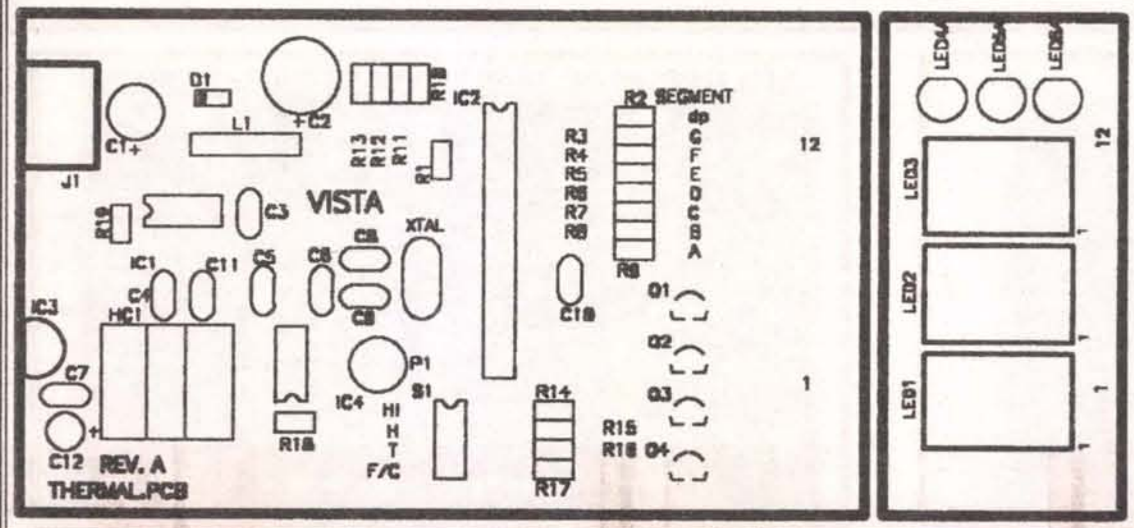


FIGURE 4: PARTS LOCATION

careful calibration for accurate results. For these reasons, P1 should be a 10-turn trim pot. The humidity sensor response is not linear and the curve has been approximated by two line segments for accuracy.

The brains of the thermometer are provided by a Microchip PIC16C63 microprocessor. This microprocessor is equipped with a 16-bit timer and a capture/compare module.

The capture feature is used as an interrupt to capture the 16th edge of the squarewave to calculate the period of the humidity sensor and solve for the relative humidity. In addition, the microprocessor is interrupted every 6.5 milliseconds to refresh the LED display digits.

All calculations are performed in double precision unsigned binary arithmetic (16 bit) to display the humidity from 0° to 99.9°. Values above or below this range will display a "HI" or "LO" on the display.

Multiplication and division routines which may require several hundred reiterations are still executed in about one-half millisecond since the microprocessor is running close to one instruction per microsecond. This would allow for a humidity update of nearly 20 readings per second.

Instead, the display routine is

We accept Visa, Mastercard, AmEx, and Discover

Attention: Gearheads

www.shrevesystems.com

To Order Call 1-800-227-3971 Fax: 318-424-9771

PowerMac 7200
75 Mhz PPC 601
4 168 pin DIMM slots
Build your own Mac!
$79 Brand New!

Global Village Bronze
External Modem
2400 Bps/9600 Fax
$1 Each

CMS Tower SCSI Case
Holds 4 5.25 full height drives
$99

Peltier Junction
with heat sink
1 3/16íx 1 3/16î
$10 each or 3 for $25

Monitor Blowout Sale!
19íí Color Monitors
Ridiculously LARGE!
Ridiculuosly CHEAP!
ONLY $49
"As Is"
No cables

Apple LW Personal NTR
$299
toner not included

Claris Works 3.0 For PC/Mac
EDOCS **$29**

Apple Color Composite Display
Great for Surveillance
Refurbished $69

Apple IIE Logic Board
$19

$19
MacAlly ADB Keyboard

Apple Remote Control
$1 EACH

Miscellaneous

Apple 8 bit Video Card	$19
LaserWriter IINT	$199
Apple ADB Keyboard	$19
1.44 Super Drive	$49
Clone ADB MouseII	$19
Quicktake 100 Camera	$129
Bernoulli 90 MB EXT	$10
Epson Document Scanners	$29
44MB SyQuest Ext	$10
88MB SyQuest Ext	$19

LC Power Supply
+5V, −5V, +12V Output
$5 New

PDA Genuine Leather Carry Case
Let your palm pilot lead the life of luxury!
$10

RAM
1 MB 30 Pin 4 For $1
4 MB 72 Pin 2 For $5

Membrane Track Pad for laptop $2

$25 minimum order

Shreve Systems
1200 Marshall st
Shreveport, La 71101

Returns subject to a 15% restocking fee.
Prices are subject to change without notice. We accept Visa, Mastercard, AmEx, Discover

Write in 128 on Reader Service Card.

slowed down by an update loop to sample only once every five seconds. The binary number is converted to BCD and then to the required bit pattern to light the individual seven-segment LED display. The display is multiplexed with all the a-elements wired together, all the b-elements, etc., to reduce the number of drive signals to eight (this includes the decimal point) which are sourced by port B.

The resultant high current produced by driving multiple segments of a digit are current-sinked by transistors Q1-Q3. These transistors are switched by a portion of port A. Port C contains the capture input pin.

Program

The source and object code for the microprocessor is available, or a completely preprogrammed microprocessor is available from the parts list.

Construction

The author's prototype humidity meter was built on a double-sided printed circuit board. A pre-etched board, drilled with plated holes and silkscreen, is available from the parts list.

This board has been designed with the placement of additional components which are not required in this project.

If you wish to make your own, Figure 2 and Figure 3 provide the artwork for a double-sided printed circuit board. The board is sized to fit a Serpac A-27 style enclosure with a clear lens. Parts layout for the prototype is shown in Figure 4.

The digital design is, in general, not critical, but special care may be required if an alternate construction method is used with the Maxim switching regulator since it operates at about 160 kHz and consideration should be given to the effects of different stray capacitance that will affect the oscillator frequency.

Start by soldering the sockets to the main board. Next, mount the resistors, diodes, inductor, capacitors, and transistors. Observe polarities on the diode, transistors, and electrolytic capacitors. The inductor should be made with a ferrite core (not powdered iron). In addition, the inductor should be rated for about 150 mA. Mount the crystal a little bit above the board so that the metal case doesn't touch any of the board traces.

Mount the three seven-segment LEDs to the display board and make sure that the decimal points of each display are at the bottom edge (closest to the edge connector). The display element's pin out must correspond to the board layout (Digi-Key LU94025 common cathode). Green display elements are preferred because they are easier on the eyes, although any color may be used.

The display board is made to attach to the main board by means of a 12 terminal 0.156" spaced right angle header (Digi-Key WM4110).

The straight section with the plastic bar should be mounted to the solder side of the display board and soldered from the component side.

The curved portion of the header is then inserted through the holes of the main board from below (the solder side) and soldered from the silkscreen side. This will result in the proper display height and set back for the Serpac A-27 case.

If a suitable header is not available, you may connect the two boards together with a ribbon cable or bare wire leads. To prevent the leads from breaking from fatigue, the front display board may be mechanically attached with a bracket or epoxy glue.

After completing the assembly, carefully check your work for cold solder joints and/or solder bridges. If you make your own board, make sure that both sides of a lead are soldered for continuity from the top traces to the bottom traces where required. This is especially important on the display board where the plated hole vias are used to transfer the signals from one side of the board to the other side of the board without a component lead present.

The DC wall transformer can supply from 6V to 15V and must be capable of at least 100 mA continuous rating. Voltages above 15V will exceed the rating of the

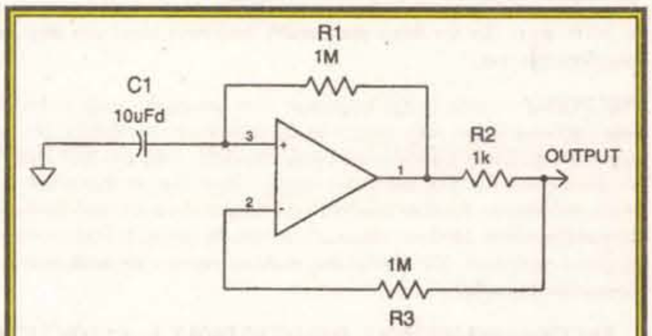


FIGURE 6: NEGATIVE CAPACITANCE MULTIPLIER

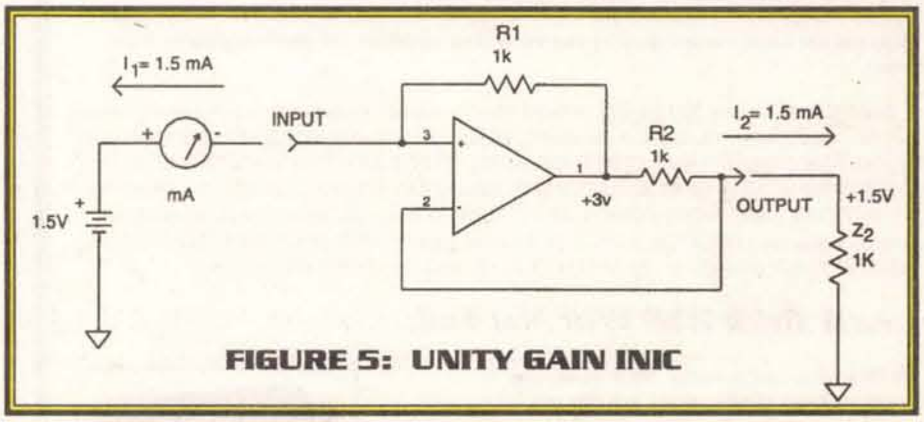


FIGURE 5: UNITY GAIN INIC

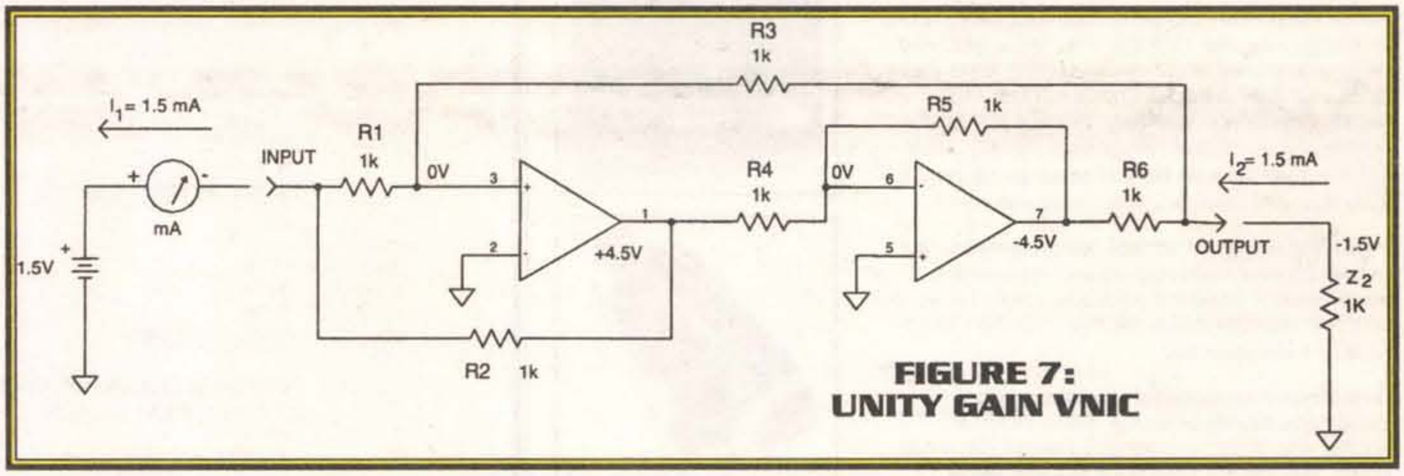


FIGURE 7: UNITY GAIN VNIC

PRINTED CIRCUIT BOARDS

QUALITY PRODUCT
FAST DELIVERY
COMPETITIVE PRICING

We will beat any competitor's prices!!!

* UL approved
* Single & Double sided
* Multilayers to 8 layer
* SMOBC, LPI mask
* Reverse Engineering
* Through hole or SMT
* Nickel & Gold Plating
* Routing or scoring
* Electrical Testing
* Artwork or CAD data
* *Fast* quotes

10 pcs (3 days) 1 or 2 layers **$249**
10 pcs (5 days) 4 layers **$695**
(up to 30 sq. in. ea.) includes tooling, artwork, LPI mask & legend

PROTOTYPE THROUGH PRODUCTION

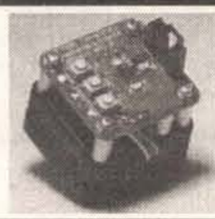
PULSAR, INC

9901 W. Pacific Ave.
Franklin Park, IL 60131
Phone 847.233.0012
Fax 847.233.0013
Modem 847.233.0014
yogii@flash.net · flash.net/~yogii

Write in 129 on Reader Service Card.

PROGRAMMABLE SOLENOID (PPS-1)

- Size 17 motor — 1.5" square; Shaft diameter — 0.196"
- Wide operating voltage (12 volts to 28 volts)
- Onboard programming



- Simple Interface only 3 wires: Power, Ground and CMD signal
- Ball bearing brushless stepper for long life
- Constant Current/ Torque

The new Picard Programmable Solenoid (PPS-1) delivers the motion capability of a sophisticated stepper motor system with the simplicity of a rotary solenoid. This eliminates the non-linear torque and erratic banging motion of a hard stop. The electronics of the PPS-1 allows the user to program and store the desired motion profile using the simple user interface. Any device that can connect a wire to ground (switch, sensor, PLC, open collector/drain output, etc.), can control the PPS-1. The innovative PPS-1 gives programmable motion of a solenoid without the expense of a costly motion control system.

$95.00 + $5 s/h

PICARD INDUSTRIES
Specializing in Miniature Smart Motors and Sensors

4960 Quaker Hill Road
Albion, New York 14411
Phone/Fax 716-589-0358
Email: jcamdep4@iinc.com
www.nebsnow.com/picard

Write in 130 on Reader Service Card.

Modern computing and standard surge suppressors... a recipe for disaster.

Almost all surge protection devices use MOV's (metal oxide varistors) as their active element. MOV's are sacrificial/wear/limited life components. Surge suppressors based on this technology are doomed to failure. These surge "suppressors" also don't suppress a thing. They divert powerline surges equally to the ground and neutral wire. When you put current on the common ground wire of interconnected equipment some of that current will flow (through the inherent ground loops) to the data lines. This is a major cause of lock-ups and misoperations that plague today's computer environments. Another fact; all modern computers use switch mode power supplies. During surges the power supply capacitors must charge to the clamping level of the MOV before the MOV turns on. A recent study has shown that it takes a 3000A surge 15 microseconds (15,000 nanoseconds) to charge the typical capacitors of these power supplies to that level. The surge is virtually over before the MOV reacts. ***(See five things you probably don't know about your surge suppressor at www.fivethings.com.)***

THE POINT: Standard surge suppressors allow too much current to hit the computer. Standard surge suppressors divert surge current to the ground wire and disrupt data transfer. Standard surge suppressors eventually fail without warning. Modern computers have logic voltage levels (the signals that transmit the data) and power supply voltages that are dramatically lower than that of their recent predecessors. Modern computers use integrated circuits with transistors of ever decreasing physical geometries. Modern computers are virtually always interconnected to other computers or peripheral equipment. The bottom line; ***modern computers are much more sensitive and susceptible to powerline anomalies.***

INTRODUCING BRICK WALL SURGE FILTERS. . .

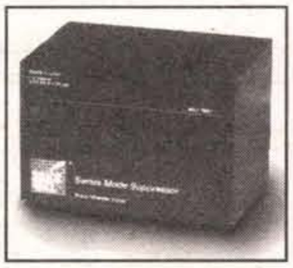
The World's Best Surge Suppressor

Initially engineered for critical, non-fail industrial applications, this patented device protects indefinitely and sets a new standard for every measure of surge suppressor and powerline filtering performance.

A Brick Wall 1) Utilizes NO MOV'S or Any Other Sacrificial Components (a two pound inductor and nine capacitors are the heart of the unit) 2) Has No Joule Rating or Surge Current Limitations *3) HAS BEEN TESTED AND CERTIFIED BY UL TO THE MOST DEMANDING CLASSIFICATION OF A NEW GOVERNMENT SPECIFICATION; CLASS I, GRADE A. Which Means: UL PUT ONE THOUSAND 3OOOA, 6000V SURGES (this is the largest surge an interior environment can experience) THROUGH A UNIT (at 60 second intervals) AND DOCUMENTED NO FAILURE OR PERFORMANCE DEGRADATION OF ANY KIND WHATSOEVER..*

i.e.: A Brick Wall Will Not Fail.

We know of no cord connected, MOV based surge protection device that has, or can pass this test.



A Brick Wall possesses UL's lowest Suppressed Voltage Rating (let-through voltage) of 330V. This is the lowest rating they will grant. In that test of one thousand 6000V, 3000A surges, *UL NEVER SAW THE LET-THROUGH VOLTAGE EXCEED 290V. YOU CANNOT DO BETTER THAN THIS FOR A POINT-OF-USE SURGE PROTECTION DEVICE.* Once again, we know of no other surge protection device that could come close to this performance level.

Available in Modular Form

A Brick Wall is a current activated *Series Mode* device. *Since it is not wired in parallel, nor voltage activated, it does not have to wait for the capacitors of the power supply to charge before it becomes effective. YOUR EQUIPMENT IS PROTECTED INSTANTANEOUSLY (and indefinitely).*

These devices were engineered utilizing a current limiting/surge filtering technology. *THEY DO NOT DIVERT ANY SURGE CURRENT TO THE GROUND WIRE. They Will Not Cause Your Computer System To LOCK-UP, CRASH OR MISOPERATE as a consequence of surge diversion. Your current surge "suppressor" will.*

Powerline Filtering
In addition to all this, Brick Wall Surge ***FILTERS*** *are the best AC powerline filters you can buy (that we have been able to find anyway). Industrial machinery, copiers, coffee makers, laser printers, fluorescent lights, refrigerators, etc., all cause powerline noise that can cause your computer to misoperate. A Brick Wall Surge Filter will make powerline noise related problems disappear.*

You Can't Buy a Better Surge Protection/Powerline Filtering Device... Anywhere.

SO. . . HOW IMPORTANT IS YOUR SYSTEM?

BRICK WALL DIV., PRICE WHEELER CORP.
1-800-528-0313
Fax: 1-800-528-6623 E-Mail: info@brickwall.com
Web: www.brickwall.com
Visa - MC - AMEX

ASK ABOUT OUR NEW IN-LINE UPS/SERVER PROTECTOR

MAX738A switching regulator. The power connector at the rear of the main board is designed for a 2.5 mm hollow barrel plug with the center pin positive.

It is always good practice to clean the printed circuit board thoroughly. This is especially true for the high impedance around the CMOS oscillator. Install the integrated circuits into their sockets and power the humidity meter up.

If everything is correct, the unit should operate and display a reading. Sensor calibration can be accomplished at a single point by trimming P1 for a similar reading by comparing it to another relative humidity meter that is known to be accurate.

Response times of different meters will vary and adjustments should only be made under somewhat stable conditions. In general, the electronic relative humidity meters respond more quickly than the mechanical types.

Alternately, the relative humidity meter can be calibrated in a standard salt solution. Several saturated aqueous solutions of inorganic salts provide a suitable calibration reference. The simplest and safest among these is a saturated solution of sodium chloride — common table salt — which provides a relative humidity point at 75.3 around 75°F.

To be accurate, the salt solution must be saturated (more salt available than will go into the distilled water) and sealed in a container such as a Corning Ware baking dish with putty around the glass cover to form a seal.

Place the relative humidity meter on a support above the solution so it will not be immersed in the solution. Allow 24 hours for the solution and sensor to equilibriate before making any adjustments.

That completes the Indoor Digital Humidity Meter project. No sweat! **NV**

Bill of Materials Quantity Type	Value	HUMID.PCB Ref Designators
	CAPACITORS	
2	33pFd	C8,C9
1	330pFd	C3
2	0.01uFd	C4,C11
3	0.1uFd	C5,C6,C10
1	100uFd/16V	C1
1	330uFd/High freq.	C2
1	PHILIPS HUMID. SENSOR (part #2322 691 90001)	HC1
	SEMICONDUCTORS	
1	1N5817	D1
3	2N4401	Q1,Q2,Q3
3	7-SEG NUM. DISPLAY (Digi-Key LU94025 Common Cathode)	LED1,LED2 LED3
1	MAX738A	IC1
1	PIC16C63	IC2
1	LMC555	IC4
	RESISTORS	
8	220	R2,R3,R4,R5,R6 R7,R8,R9
3	4.7k	R10,R11,R12
1	100k	R1
1	2.2M	R18
1	500k, 10 TURN	P1
	MISCELLANEOUS	
1	2.5 mm POWER JACK	J1
1	4MHz	XTAL
1	100uH ,150mA ferrite core	L1
1	VISTA TEMP.PCB	
1	VISTA DISPLAY.PCB	
1	+5V WALL XFORMER/100MA	
1	28-PIN DIP SOCKET	
2	8-PIN DIP SOCKET	
1	SERPAC A27 CASE	
1	12 Position 0.1" HEADER (Digi-Key WM4110)	
1	KESTER 331 SOLDER	
	TOTAL 46 PARTS	

The following parts are available from Vista, P.O. Box 1425, Bolingbrook, IL 60440-1532, (630)-378-5534.

- Complete Digital **HUMID-ASSEM** and tested for **$89.00**
- Complete Digital **HUMID-KIT** containing all parts with case for **$72.00**
- **HUMID-SOFTWARE** source program on 3.5" floppy for **$19.95**
- **PIC16C63** Pre-programmed microprocessor for **$15.00**
- **PHILIPS HUMID. SENSOR** for **$12.50**
- **MAX738A** IC for **$7.50**
- Vista Digital **HUMID-BRD** board for **$13.00**

All mail orders will be shipped by first class U.S. mail with a shipping and handling charge of $3.00. All phone orders will be shipped by U.S. priority mail with a shipping and handling charge of $6.00. Illinois residents must include 7.5% sales tax.

SUPER FINANCING
Netcom #1 in Customer Service Since 1983
IBM ROAD WARRIOR
Professional Road Equipment
4 easy payments of $199.99
0% Financing! On Credit Cards only
MAXIMUM ABUSE
strictly for professionals
Blazing Sunlight or Rain Storm
On the DESERT or SNOW
Instant ON - ZERO boot up time
Drop 3' to Concrete
Rain: (4"/hr Rain w/ 40 MPH Winds)
Silicone Rubberized & Diecast Case !
Ultra Shock Mounted 1GIG EIDE Hard Drive !
ESD / EMF & RF Resistant, Works from -4 to 120 Deg F & Vacuum to 15,000 ft
> 1- PCMCIA (type 1, 2 or 3), Serial & Parallel Ports in rear
> 16m Ram / 1m Video / 32 Bit Local Bus 486-50 Mhz & Math Co-processor, 28.8k Modem (Internet Ready)
> Very Long Lasting Hydride Battery ($150 Value)
> Sound & Microphone,
> 8.25" Display-64 Shade Monochrome REFLECTIVE
> (Optional) Touch Screen with Handwriting Recognition
Rough Service Handle with Loops for optional Shoulder Strap
Roxanne's Voice Annotates Windows 95 Functions
OPTIONS
> Floppy Drive $89 > 12V Car cord $29
> Desktop 48X Cd Rom $159
> Touch Screen $250
> 33k Baud PCMCIA Fax- Modem Upgrade $35
This was a unique (one shot) purchasing opportunity
IT'S NOT OPEN STOCK
WHEN THEY'RE GONE, THEY'RE GONE FOR GOOD
Sold till recently by IBM through their Local Area Network Div at $4,699 & $6,912 as shown here. (they were never discounted)
Perfect for GPS Satellite Navigation
Actual Selling Price From IBM $6,912
Y2K Ready
Sturdy Handle
Rubber Sides
IBM
Tough!
233 Mhz Pentium
Our BEST Selling Computer EVER!
4 Easy payments of Wow $249!
0% Financing! On Credit Cards only
Compare at $1,500
The Commuter
Y2K Ready
Stereo
Ultra Fast
3YR! WARRANTY
FREE Carry Case This month only
Looks so nice in person, it'll give ya Goose Bumps
Low Price / High Performance
233mhz
3.2Gig
32m ram
56k modem
CD 24x
USB (2)
W98
Includes CD & Floppy / High Resolution Razor Sharp 8" TFT SVGA Color Display Supports High Resolution modes up to 1024x768
Super Built-in Stereo Speakers & Mic / Excellent Touch Pad Mouse
Long life Lithium Ion battery / 2 USB ports, IR Port, All standard ports
2 PCMCIA Ports / Super Lightweight 3.3 lb 9.5 x 7 x 1.5 Built-in palm rests
3 Year Warranty (best in the industry) FREE Lifetime NetcomTech support
OPTIONAL CUSTOM Carrying Case $24 SOYO Embossed LOGO, Tailored fit, Pockets, Handle & includes Shoulder Strap
SOYO is the leading maker of Computer Motherboards for FAMOUS BRAND NAME computers. The "Commuter" has every "State of the Art" feature you want at a Spectacular price. Runs ANY program with ease. This Ad was created on this machine!
Light weight & Ultra portable The PERFECT GIFT
IBM Thinkpad Pentium P-75
Huge 10.5" TFT Active Matrix SVGA Color Display (the Best)
33k FAX MODEM - 2 PCMCIA Expansion Slots
Dual Infrared Ports (Front & Rear)
Track Point Eraser Head Mouse (Very Responsive)
All Standard Ports (1S,1P,1VGA,1Kbd)
Pop out - Hard Drive, Ram, Battery & Floppy.
Ram & Hard Drive Expandable & Upgradable.
Includes Power Supply & Hydride Battery
Free Lifetime Tech Support Web Site Creator Software
Internet Ready, America On Line (Full install)
Fax Modem Software, Searchable Owners Manual s/w, W95
2 Gig Hard Drive
24M Ram
Wow 0% Financing on Credit Cards only
4 Easy payments of
Pent-75 $215!
INCLUDES DOCK
WHILE SUPPLY LASTS (Don't Wait)
DX4-100 (SOLD OUT)
Orig $3,499 450 Dock $3,949
Y2K Ready
Racy
IBM
IBM Docking Station INCLUDED
This is not just a port expander it's a full blown docking station
You can add ANY desktop ISA card and it will work with your IBM laptop
Imagine the posibilities. Add a TV card and watch TV while you compute !
ISA computer card hides in the base of the unit.
From IBM $450
FREE Local Area Network (LAN) card (a $79 value) Notebook Snaps onto the dock.
Expansion Port for optional CD Rom Built-in Speakers Built-in Power Supply & Fan
SCSI Expansion Port / Parallel / Serial / Keyboard / Mouse / Monitor / Stereo in & out
Front panel headphone Jack Hidden Carry handle LED Status Indicators
Color Black (matches notebook) ISA Port cover & Key optional (not required)
Over a Quarter Million Devices
2 Easy Payments $49!
FREE Upgrade which will Include a Huge, Asian Transistor Spec Database: $69option in the new version
"REFEREE" CROSS REFERENCE & SPEC
Transistors, ICs & Diodes
A Specialist in "Hard to Cross House Numbers"
Easy, Powerful & Fast.
The Most Comprehensive Software Sold.
Yields Device Specifications & 75 to 250 Potential Replacements !
Replacement Numbers are Totally Global including Domestic, Asian, European, House, Branded, as well as ECG, NTE, SK & GE. Displays Case Drawings, Lead Configuration & Pin-outs for many Devices. Coverage of Replacement Numbers is Very Impressive. 7 Disk Set (17 Meg decompressed) For DOS, W3.1 & 95, 98 & NT.
Includes:
4 HUGE Consumer Electronics Industry Directories
1- Consumer Electronics Parts Sources (Service) 2- Consumer Electronics Manufacturers 3- The Entire Computer Industry 4- Semiconductor Manufacturers
#1 Choice of Service Centers
Limited Time
IC Master $29!
Oh My GOD !
NETCOM
ICM Bible of the IC Industry
Every Cross-reference
3 Volume Set with Tons of Information
ICMaster Earlier Editions Perfect for Service or Lite Design. Later Editions Perfect for Advanced Design
ICM $195 Publisher
95 3Book Set $29 !!!!!!!!!!
96 3Book Set $49 !!!!!!
97 3Book Set $69 !! CD Rom $ 99.!!
98 3Book gone CD " $129!
99 3Book gone CD " $179!
EEM Contains the Complete Catalogs of Most Electronic Component Manufacturers & Distributors
$149
EEM
97 4 Book Set only on CD $35
98 4 Book Set only on CD $55
2000 4 Book Set $79
Year Warranty - Satisfaction Guaranteed - The Friendliest People - The Best Customer Service
Email for Detailed Information
PAYMENT PLAN with Credit Card -or- Layaway ONLY
843-650-5700 For Questions-or- email: netcomd@aol.com
COD's SINGLE PAYMENT ONLY
ORDERS ONLY 800-733-3733 ORDERS ONLY FAX 843 650 5777 10 - 8 EST Mon - Fri

reader FeedBack

Dear Nuts & Volts:
This is concerning the answer you published for #99912.

The answer you published is good if the only password you are trying to bypass is the Windows password. There is a procedure that has to be done to erase the password out of the CMOS set up.

Some computers have a jumper that has to be set with the power off, then turned on for a second or two, then turned off again and the jumper set to the original configuration. This requires that the computer be opened for access to the motherboard.

MicroHouse out of Boulder, CO is a good source for computer board configurations. Also the manufacturer should be contacted first.

There is another procedure that requires some electronics knowledge. It can be done two different ways.

The first requires that the CMOS battery be disconnected and the computer let sit for a day or two with the power turned off (time consuming).

The second and quickest requires that the CMOS battery be removed and the battery connections on the circuit board be shorted out. If this does not work, then there are a couple of diodes in the circuit that have to be shorted also.

I have had to do this procedure to save a system when a used motherboard was used for repairs or to access a system when the password was forgotten and no records were kept. This procedure requires caution so that the motherboard is not damaged.

If possible, while you have the computer open, determine the hard drive type/configuration, once you have reset the CMOS password you are going to have to reset all of the setup configuration information.

Once again, caution should be used.

Gary A. Floyd, Vacaville, CA

Dear Nuts & Volts:
I am a long time subscriber of *Nuts and Volts* magazine and have enjoyed your publication for many years. I ran across an interesting product that I believe would be of interest to many of your readers.

The product is Liberty Basic. It is a Basic Language that enables individuals to easily write fully functioning Windows applications. This package has it all. Graphical user interface, easy to use syntax, and all the hooks, bells, and whistles to automate anything.

It would make a great control system for a home automation project or to interface with BASIC Stamps.

The shareware version of the software, complete with tutorials and samples programs, can be downloaded from www.libertybasic.com. There is also a link to the author at that address. Registration is only $40.00 and enables the distribution of software using a run time engine.

Please take a look. I am very excited about this project. I am sure many of your readers will be too.

Kim J. White
kjwhite@looksmart.com

Newsbytes

The Character Computer Mouse for Children

Aguila Enterprises of Worcester, MA has introduced to the US computer marketplace, the original children's Character Computer Mouse.

This unique new children's accessory hit the toy and computer industry this fall. Each character mouse is ergonomically designed for a child's hand and features luminous indicators in their eyes. A complete product line of character mice will include a turtle mouse, sneaker, lady bug, snail and, of course, a mouse!

All mice are serial PC compatible. Aguila Enterprises — a privately held company — will implement and manage a comprehensive distribution program for US computer superstores, software retailers, and mass distributors.

Tested and proven in Europe, the turtle mouse has already captured a Gold Medal in the category of Novelty-toys and Best Educational Item at Inpex 14, Americas Largest Invention Show.

The turtle mouse can also boast of International recognition in the categories of Foreign Invention and Teaching Methods.

An exciting new door of opportunity has been opened for the computer industry with this patent-pending invention, retailing at $33.99. Now possible is the ability for software manufacturers to custom design any mouse through Aguila Enterprises.

For more information and pictures of the character mouse check out the websites at:

http://www.harb.net/aguilaenterprises or http://www.lobotronic.com

All inquiries should be made to:

Michael Smith
36 Bowdoin St.
Worcester, MA 01609
Ph: 508-363-3951
Fax: 508-791-9756
E-Mail: aguila36@flash.net

•

Quickly Diagnose Your Internet Connection Using DOCTORZ

Zugg Software has released version 1.20 of DoctorZ, a Windows-based software package that tests your connection to the Internet and pinpoints any problems. DoctorZ is the fastest Internet tester available for Windows, and uses an expert system which learns about your network connection over time to improve it's speed and diagnostic abilities. An easy-to-use graphical interface reports results in plain text without the jargon used by most other troubleshooting programs. Extensive tutorials teach novice network users about the Internet, how problems occur, and how they can be detected with DoctorZ.

DoctorZ is not a simple "ping" or "traceroute" program, but can test any network service, such as E-Mail or world-wide-web servers. DoctorZ can perform tests in the background at a specified interval. Results can be logged to a file, sent via E-Mail, or generate alarms. Information about domain name registrations, E-Mail accounts, and web page source and headers can also be examined. All settings in DoctorZ are saved across multiple sessions, including previous testing results.

DoctorZ is available for Windows 95/98/NT/2000. Proxy servers are supported for specific network service tests. DoctorZ is Y2K compliant.

DoctorZ costs $10.00, with all future versions and upgrades available for free. DoctorZ is available for immediate download from Zugg Software at:

http://www.zuggsoft.com/

For more information, contact:

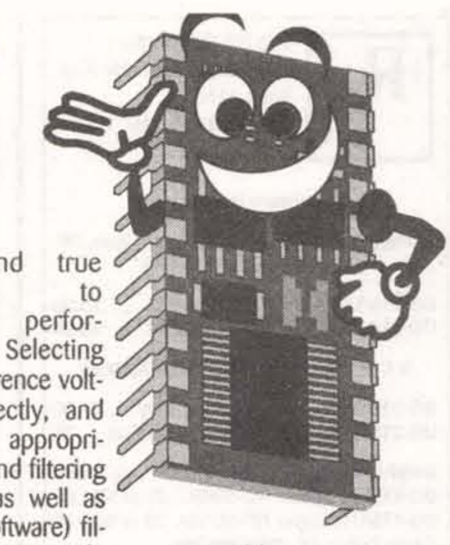
Zugg Software
681 43rd St.
Los Alamos, NM 87544
E-Mail: zugg@zuggsoft.com
Voice: (505) 662-0798.

•

Continued on page 92

STAMP APPLICATIONS

by Lon Glazner



Putting the Spotlight on BASIC Stamp Projects, Hints, and Tips

Getting the Most Out of Your 12-Bit ADC

In this installment of Stamp Applications, we'll take a look at a couple of simple circuits that allow you to make the most of your ADC.

Overview

Analog-to-digital converters (ADC) are ubiquitous components in the world of embedded control design these days. Many microcontrollers have on-board ADCs, and the resolution of these ADCs is increasing on a regular basis. But an increase in resolution does not necessarily translate to an increase in measurement accuracy.

A Bit About Analog-to-Digital Converters

There's a little bit of ground to cover in discussing ADCs in general. I'm not going to go into a dissertation on analog conversion technologies but, for those of you that have never used one before, some of the basics may be helpful.

ADCs come in a wide variety of flavors. When interfacing to a BASIC Stamp, I lean towards those that have serial interfaces. This reduces the number of pins required to control the ADC, and I/O pins are like gold in a BASIC Stamp design. The Serial Peripheral Interface (SPI) seems to provide the simplest interface software, and requires only three I/O lines from the BASIC Stamp.

ADCs also come with a variety of "channels." The term channel refers to the number of ADC measurement points on a specific IC. For instance, a four-channel ADC would have four pins where analog voltages may be measured. The digital interface software determines which channel is being measured for any given data sample.

ADCs also come with a variety of resolution ratings. An eight-bit ADC can return 256 different values for any given sample (including a result of 0); a 10-bit ADC has 1,024 different values; and a 12-bit ADC has 4,096 values. Virtually all ADCs have reference voltage inputs, usually labeled VREF or REF. The voltage at this point determines the full-scale value associated with an ADC measurement. For instance, an eight-bit ADC with a reference voltage of 5.0VDC would return a 255 (binary %11111111, or hex $FF) if 5.0VDC were present at the channel being sampled.

So, what is the voltage resolution in our eight-bit ADC with a 5.0VDC reference? This can be determined by dividing 5 by the number of possible values the ADC can provide.

Or... 5.0V / 256 possible values
= .01953V / value

Our eight-bit A/D has a resolution of 19.53mV per bit. The accuracy is usually ±1 least significant bit (LSB), which means that your measurement can be expected to be off by ±19.53mV for any given measurement (ADC measurements are often called "samples").

Engineers will often be required to design analog measurement devices which require greater resolution and better accuracy than described above. For the novice, there is a desire to select a 10- or 12-bit ADC and call it good. This can be a dreadful mistake. After all, even if your ADC has a resolution of 1mV per bit, if there is 8mV of noise on your ADC input, you've effectively reduced your ADC to nine bits of resolution. In other words, you've paid for the 12-bit device, but your performance is only a little better than an eight-bit ADC.

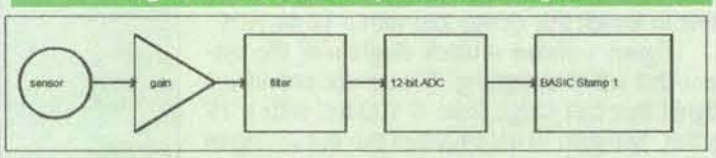
Don't throw out the ADC though, there are a few tried and true methods to increase performance. Selecting your reference voltage correctly, and providing appropriate gain and filtering circuits, as well as digital (software) filtering can produce respectable results.

Defining the Design

A good way to get a grasp on some of the particulars of making accurate ADC measurements is by walking through a design. Consider this article ADC-101. There will be areas specific to certain input voltages or signal types that we'll not concern ourselves with, there will also be certain types of noise that we'll ignore for the most part. A great example of this is PCB layout. Poor physical PCB layout, as well as improper grounding, de-coupling, and bypassing techniques have much greater effects on your ADC performance than the improvements granted by the filter circuits we'll cover here. I can't cover all of these issues in one article, but I'll be sure to point out some references for those aspects of ADC measurements that are being omitted.

One last warning before we're off and running. Highly accurate analog measurement systems often have to be calibrated to make full use of the circuitry associated with them. We'll touch on calibration in software, but we won't go into a complete analysis of how to design out component offsets and other error factors through software or hardware calibration.

Figure 1 — 12-Bit ADC System Block Diagram



PRINTED CIRCUIT BOARDS
Since 1969
Prototype to Production
Quick • Quality • Service • Price
•Single Sided
•Double Sided
•Multi-Layer
•Surface Mount
•Punch Press Capability
•LPI
QUICK TURN AROUND
COMPLETE IN-HOUSE CAPABILITY
CIRCUIT ETCHING TECHNICS
Since 1969
700 Lee Street
Elk Grove Village
Illinois 60007
Phone: 847-228-1722
Fax: 847-228-1816
Modem: 847-228-6549
Toll Free: 888-657-3827
E-MAIL — CET@MET-NET.COM
WEB ADDRESS —
WWW.MET-NET.COM/USERS/CET
Write in 34 on Reader Service Card.

PIC'n Books
LEARN ABOUT PIC MICROCONTROLLERS

See Table Of Contents: http://www.sq-1.com
Secure Online Ordering Is Available
PIC is a trademark of Microchip Technology Inc.
SQUARE 1 ELECTRONICS
Voice (707) 279-8881 Fax (707) 279-8883
http://www.sq-1.com

The RF Connection
213 North Frederick Ave.
Suite 11NV
Gaithersburg, MD USA
20877

http://www.therfc.com/

Complete Selection of MIL-Spec Coax, RF Connectors and Relays

UG-21B/U N Male for RG-213/214........$5.00
UG-21D/U N Male for RG-213/214........$3.25

N Connectors for 9913/Flexi4XL/9096

UG-21B/9913..... $6.00 **Pins Only**......$1.50
UG-21D/9913..... $4.00 **Extra Gasket**..... .75

Amphenol 83-1SP-1050 PL-259..........$0.90
UG-176/U Reducer RG-59/8X. .25 or 5/$1.00
UG-175/U Reducer RG-58/58A .25 or 5/$1.00
Silver Teflon PL-259/Gold Pin...................
.... $1.00 or 10/$9.00

MIL-Spec Coax Available (Teflon, PVC IIA)

New Product: Belden 9913F. 9913 with High Density PE Foam dielectric, stranded center cond. and Duobond III Jacket............
.... .80/ft or $76.00/100ft

Also New: 9092, RG8X with Type II Jacket
Intro Price................................$23.00/100ft

Call for Specials of the Month

Full Line of Audio Connectors for Icom, Kenwood, and Yaesu

8 Pin Mike Female...............................$2.50
8 Pin Mike Male Panel.........................$2.50
13 Pin DIN for Kenwood.......................$2.75
8 Pin DIN for Icom...............................$1.00
8 Pin DIN for Kenwood.........................$1.50

Prices Do Not Include Shipping

Orders 800/783-2666
Info 301/840-5477
FAX 301/869-3680

Write in 35 on Reader Service Card.

www.mouser.com

Subscribe, download, or view catalog online!

800-992-9943

817-483-6828
Fax: 817-483-6899

catalog@mouser.com

958 N. Main St., Mansfield, TX 76063

MOUSER ELECTRONICS

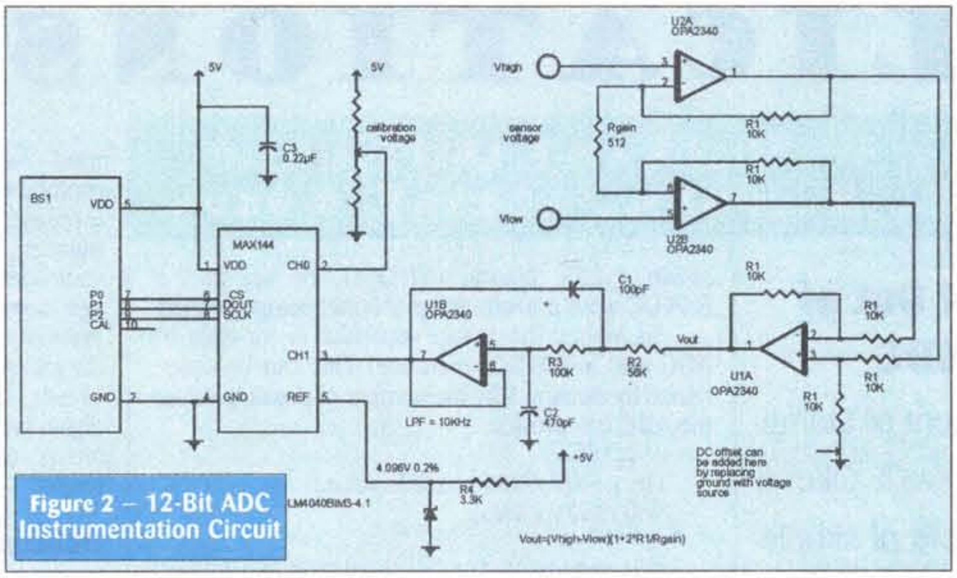


Figure 2 – 12-Bit ADC Instrumentation Circuit

Design Statement

We've been presented with a sensor that outputs a minimum voltage of 1VDC. The full-scale value of the sensor is limited to only 1.1VDC (full-scale is the largest value that will come out of the sensor). It's our job to provide a circuit that can accurately measure the voltage provided by this sensor. To complicate matters, our boss – the grand Pooh-Bah – wants a resolution of 50uV, and an accuracy of ±50uV in our measurements. There may also be some noise at about 100kHz coming from a component near where our circuit is being placed. We weren't given any specifics on this device, just a heads-up on the potential for some noise at this frequency.

It is pretty clear that just hooking up a 12-bit ADC to the sensor would not provide the kind of resolution that our slave-driver boss requires. But if we provide an amplifier block (or gain block) and some analog filtering, we might just be able to knock this design out with a 12-bit ADC.

Figure 1 shows a block diagram of the system that we're designing. The sensor provides a signal that can range from 0-100mV, with a 1V offset. The gain block amplifies the sensor signal so that the full range of the 12-bit ADC can be used. The filter block is a simple two-pole, low pass filter with a cut-off frequency in the area of 10kHz.

The Hardware

For the hardware design, we'll tackle first-things-first. A two-channel, 12-bit, SPI-ADC would be ideal for this design. The MAX144 (from MAXIM Integrated Products, www.maxim-ic.com) seems to fit the bill, as far as ADCs go. We'll be using a precision voltage reference – the LM4040BIM3-4.1 – from National Semiconductor to provide a voltage reference of 4.096V for the MAX144. There is a significant benefit to making this choice. The 4.096V reference voltage means that every bit measured relates to exactly 1mV (from 4.096V / 4096 possible values).

The gain block and filtering can be done with op-amp circuits. It's a good idea to select op-amps that were designed specifically for instrumentation and ADC interfacing. The OPA2340 from Burr-Brown provides a solid dual op-amp for our purpose. The OPA2340 provides rail-to-rail outputs (to within 1mV) and operates on a single +5V supply. These parts also have a low offset voltage (less than 1mV) which can help reduce measurement errors.

The complete circuit schematic is displayed in Figure 2. The gain block is made up of the two op-amps in the U2 package. The gain for this circuit is set to 40. A gain of 40 applied to a full-scale sensor output would generate a 100mV*40 = 4.0V output. The additional 0.096V provides us with a little headroom. We can expect the total voltage output to the low-pass filter to remain less than 4.00V, which is less than the full-scale measurement range of the MAX144.

We know that each bit returned by our ADC is related to a 1mV measurement. Since this 1mV resolution is gained up by 40, the actual value per bit is 1mV / 40 = 25uV, which meets the criteria for this design. From the design needs, we were allowed ±50uV accuracy, and that translates into a little room for error.

There are a couple of loose strings that should be tied up at this point. The first relates to the OPA2340 parts. I did not show the power or ground pins in the schematic, nor did I show the 0.22uF bypass capacitors which should be located as close as possible to the power pin and connected between the power and ground connections for each op-amp. These capacitors are important and should not be omitted.

Along the same lines, the MAX144 data sheet specifies some layout requirements, which should be read, and adhered to, if you intend to place the MAX144 into any of

Code Listing: NV100.BAS Interfacing to the MAX144 12-Bit ADC

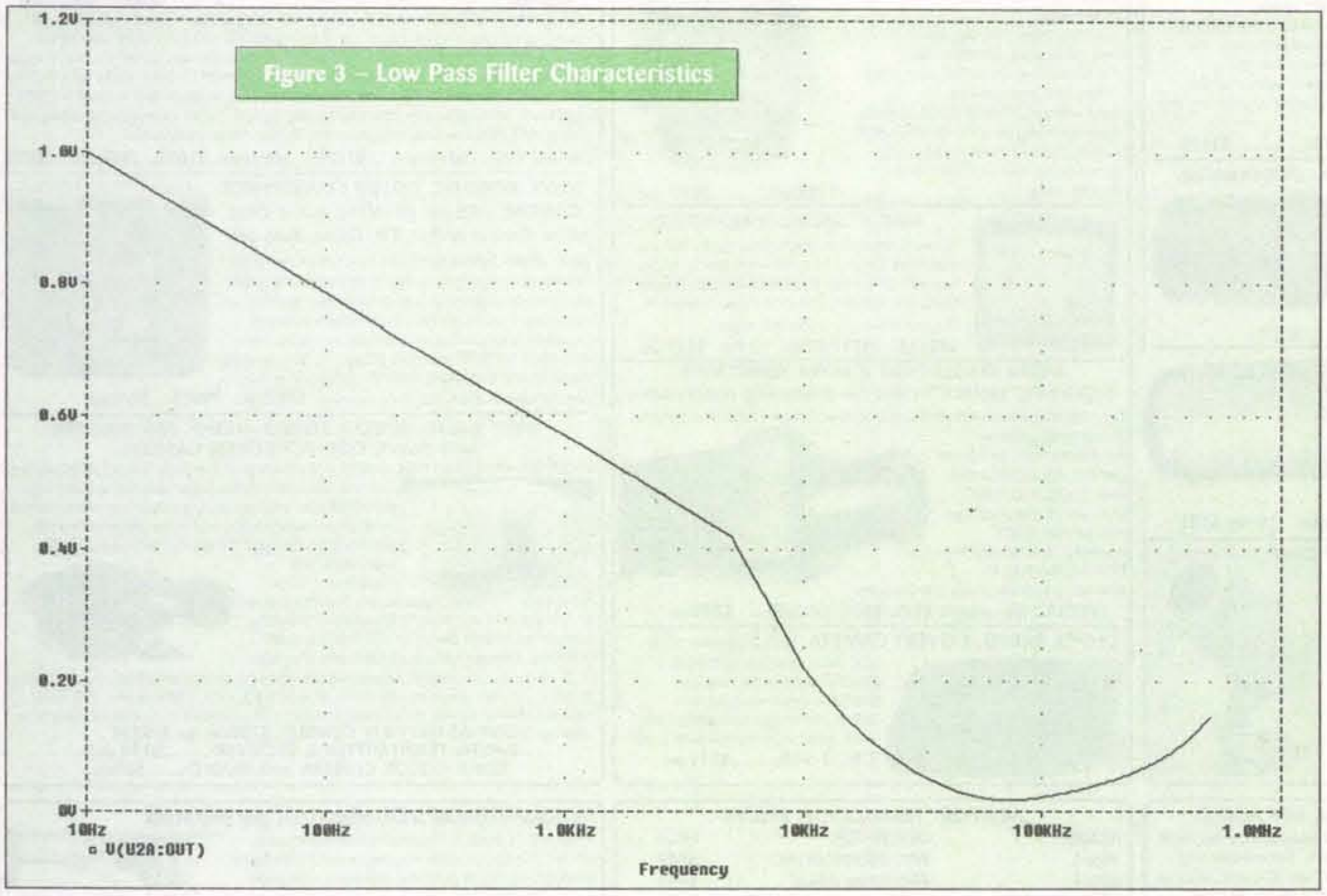
```
SYMBOL      CS_AD        = 0
SYMBOL      SDATA        = 1
SYMBOL      CLK          = 2
SYMBOL      DATpin       = pin1
SYMBOL      Ad_flag            = bit12

SYMBOL      CLOCKS       = B2
SYMBOL      SAMPLES      = B3
SYMBOL      AD0_CAL      = W0
SYMBOL      AD1_IN             = W2
SYMBOL      WORK         = W3
SYMBOL      AD_RESULT    = W4

BEGIN:
      LET DIRS = %11111101
      PAUSE 1000
MAIN:
      GOSUB ANALOG
      GOTO  MAIN

'****************************************************
ANALOG:
      HIGH  CS_AD
      HIGH  CLK
      AD_RESULT = 0
      FOR SAMPLES = 1 TO 16
            LOW   CLK
            LOW   CS_AD
            LET AD0_CAL = 0
            FOR CLOCKS = 1 TO 16
                  LET AD0_CAL = AD0_CAL * 2
                  LET AD0_CAL = AD0_CAL + DATpin
                  PULSOUT CLK,10
            NEXT
            IF    BIT12 = 1 THEN ANALOG
            AD0_CAL = AD0_CAL&$0FFF
            HIGH  CS_AD
            HIGH  CLK
            LOW   CLK
            LOW   CS_AD
            LET AD1_IN = 0
            FOR CLOCKS = 1 TO 16
                  LET AD1_IN = AD1_IN * 2
                  LET AD1_IN = AD1_IN + DATpin
                  PULSOUT CLK,10
            NEXT
            AD1_IN = AD1_IN&$0FFF
            HIGH  CS_AD
            HIGH  CLK
            WORK = AD1_IN + 2500 - AD0_CAL
            AD_RESULT = AD_RESULT + WORK
      NEXT
      AD_RESULT = AD_RESULT/16
      DEBUG AD_RESULT,CR,CR
      RETURN
'****************************************************8
END:
```

Figure 3 – Low Pass Filter Characteristics



your designs. Finally, the channel 0 connection was used to measure a calibration voltage provided by a 1K potentiometer configured as a voltage divider. While this is not strictly necessary, it made calibration much easier during initial testing.

To finish up the hardware design, a simulation of the filter circuit was completed to ensure that it would adequately cut off any 100kHz noise that might be coupled onto our sensor signal lines from the noise source our boss had mentioned earlier. The filter output versus frequency is displayed in Figure 3.

The Software

The software is pretty straightforward for this system. Although, there are a few "gotchas" that I need to mention. One issue of concern is the manner in which the two channels of the ADC are selected. The MAX144 alternates channel 0 and channel 1 with each sample operation that you perform. It starts with channel 0 selected at power-up. This can create some problems.

If you're like me, you might make a modification to your BASIC Stamp code and then download the software to your Stamp without cycling the power off and then on. This could place your software out of sync with the MAX144. You would be reading channel 1 when you expect to read channel 0.

A simple way around this is to sample the MAX144, and then test the 12th bit in the returned word. If the bit is clear ("0"), then you have just read channel 0. If it is not clear, then you should set the chip select and clock lines high and attempt to read the MAX144 again. The second attempt will provide the sample from channel 0. You only need to do this as part of a software routine for reading channel 0. Once you have successfully read channel, 0 your BASIC Stamp will be in sync with the MAX144.

You'll notice in the software that the highest nibble of each returned sample is cleared by ANDing the sample result with $0FFF. This clears the channel information returned with each sample. The resulting data can be summed with other samples to provide a simple averaging routine. In the software listing for this design, there is a 16 sample averaging function being performed. Summing any additional samples would run the risk of overflowing the storage register AD_RESULT. Also keep in mind that any routines that manipulate the data will have some effect on both your accuracy and your measurement resolution. Averaging, in particular, has a tendency to reduce the value of the data that you are manipulating.

In this design, channel 1 of the ADC is actually measuring the sensor-input voltage. Channel 0 is used to read the voltage from a calibration potentiometer. With each pass through the program, the results from channel 1 are added to 2500 (2500mV) and then the result from channel 0 is subtracted from channel 1 + 2500mV. In a system with no errors, you would set your potentiometer to 2500mV. If you found that your system was outputting voltage readings 10mV too high, you would set the potentiometer to 2510mV.

A simple way to get a ball-park calibration value is to tie both sensor inputs to the same point and adjust your calibration potentiometer until the AD_RESULT register reads a "0." This is a very simple calibration technique that could be adversely affected by component aging, vibration, and temperature, among other things. But it does present one of the more powerful aspects of designing with embedded controllers.

In Closing

In the lab, I was able to calibrate this system and achieve an accuracy of ±50uV, as well as reach the target resolution of 50uV. In fact, the sample resolution was good down to 25uV steps. I did have some trouble reading values lower than about 300uV but, when I got above that threshold, the system was doing its job well.

This circuit was built on a solderless breadboard, which is about the most unforgiving place that you can test a design that is highly susceptible to noise. I had intended to work out the basics and move the circuit to a copper board for "dead-bugging" (a prototyping technique where the parts are soldered to a copper ground plane), but the circuit performance was adequate for the testing that I required.

To summarize the techniques used to build accurate ADC-based systems, I think the following five points cover most concerns ...

1. Define your accuracy and resolution requirements before selecting a specific ADC.
2. Select accurate voltage references that are compatible with your ADC.
3. Add gain blocks to make use of the full span of your ADC's measurement range.
4. Provide analog filtering for the signals that you intend to measure.
5. Read the manufacturer's data sheets for layout recommendations and other important insights into any ICs that you expect to use.

For anyone interested in working with this circuit, all of the components mentioned in this article can be purchased from the on-line catalog company **Digi-Key (www.digikey.com)**. See you next month. **NV**

JFETS
ULTRA LOW NOISE
LS843 - 3nV/Hz typ
TIGHT MATCHING
LS843 - 1 mV max
◇ N & P Channel
◇ Duals & Singles
◇ Custom Screening
◇ Die, SMT, Thru-Hole
◇ No Order Minimum
◇ COD's Accepted
Second Source for Domestic & Foreign JFETs & Bipolars
Full Service U.S. Manufacturer of Specialty Linear Products
LINEAR SYSTEMS
4042 Clipper Court
Fremont, CA 94538
510-490-9160/510-353-0261(Fax)
E-mail: 3623671@MCIMAIL.COM
Write in 37 on Reader Service Card.

RESOURCES

For more information on the BASIC Stamp, contact:

Solutions Cubed
Lon Glazner
3029 Esplanade Suite F
Chico, CA 95973
E-Mail: **lon@solutions-cubed.com**
www.solutions-cubed.com
Phone: **530-891-8045**
Fax: **530-891-1643**

Parallax, Inc.
3805 Atherton Road, #102
Rocklin, CA 95765
phone **(916) 624-8333**
http://www.parallaxinc.com

Scott Edwards Electronics, Inc.
1939 S. Frontage Rd. Ste. F
Sierra Vista, AZ 85635
phone **520-459-4802**
fax **520-459-0623**
www.seetron.com
info@seetron.com

SUPER VACUUM PUMP, LEYBOLD, TRIVAC B, type D16, #91266-2

Dual stage, oil sealed, rotary vane pump with a 11.7cfm pumping capacity and an ultimate vacuum of 8x10^{-5} mbar.

This brand new pump is powered by a three phase, 1HP, AC motor with built in thermal protection. The motor can operate on 200 / 230 or 460 VAC. Completely modular construction for easy maintenance. The unit weighs 78lbs. A super special item only one available.

LEYBOLD D16...............$1695

NEW! NOW YOU HAVE COLOR (down to 60 ft.) UNDERWATER.

Sleek black anodized, BRASS, housing. O-Ring sealed & WATERPROOF. Adjustable mount incl. Specs: 1/4" CCD, 350 Lines res., 0.5 Lux sensitivity, AGC, Auto Shutter. 12VDC @120mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable. Perfect as a remote area inspection camera. Great for weatherproof general outdoor use as well. **GM-400KW.......$219**

MINIATURE and, PRECISE, PORTESCAP, SWISS, GEARMOTOR.

State of the art "ironless" type, mini motor type M11-210-54-0 with approx: 40:1 gearbox. Size: 16mm d. x 43mm L Operatir parameters: @6VDC input, 8mA, 141RPM Nc Load, @ 12VDC input, 12mA 290RPM No Load

PORTESCAP, TYPE B: $15ea. 2 for $27, Special....10 for $125

ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAM

Sleek black anodized, alum. housing. O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mmdX50mm, 36" cable with BNC video & DC barrel jack.

GM-200K, PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 once! Size only 23mm d.x35mm long. Think of the places you could put this little jewel.

GM-200K-STD...........$99
GM-200K-PH lens.....$99

MOTORIZED, INDOOR PAN & TILT with CONTROLLER NEW, PT100-C provides dependable motion control.

SPECIFICATIONS:
Movement range: 350° Pan, +/-60° Tilt
Pan.4° /sec., Tilt: 3°/sec
Load rating:
Pan: 7kg, 15lbs., Tilt: 4kg, 8lbs.
Pan: continuous, Tilt: intermittent
Cable req'd.: 6-conductor, unshielded
Finish: light gray textured
Input voltage: 117VAC@ 0.02A, 6 watts
Operating temperature: -25°C to +60°C
Construction: aluminum and plastic
Dimensions: 184H x 115mm diam.
Weight: 1.9kg

SPECIAL..........$289 set

NEW, 9" SECURITY MONITORS

We were fortunate to obtain these Hi-res 700 Line B&W units. Original manufacturers boxes, 90 day warranty. BNC video in and loop through. Rugged steel case. Current production model. Limited qty. They will make your video look super!

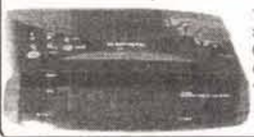
SPECIAL...$119.00ea. 2 for $229.00

ULTRA RESOLUTION & ULTRA SENSITIVITY, SCIENTIFIC QUALITY CAM for demanding applications.

Type GM-600, offers 425K pixels, 600 Lines resolution < 0.02LUX sensitivity. Access to all operating parameters from outside the camera! Adjustable shutter speed, gain, auto/man. gain, external/internal sync and gamma. 12VDC powered. Dual mounts. Sony CCD! Just the thing for astronomy, scientific or extreme low light.

SPECIAL this month REG. $349, GM600.......$299ea.

CLOCK RADIO, COVERT CAMERA, New, Magnavox clock radio with covert low light video camera. Specifications per our GM1000A shown on page one. Connect the output to anything with a "video Input" jack. via RCA style ouput.



CRC-1-STD,........$119.ea

CO2, 120Watt CW, SEALED GLASS LASER HEADS
Integral Hard Sealed Mirrors, NEW!

High quality water cooled heads. Were originally designed for medical application. All models are similar in construction. Size of the model 103: 60"L x 3.2"diam., Model 160: 44"L x 3.2"diam. Model 135: 35"L x 3.2"diam. Power requirement, model 103, 40KV trigger with 25KV @ 10 to 30ma operating current. Model 160 and 135, 30KV trigger with 15-20KV @ 7 to 20mA operating current. These are not toys. They must conform to Class IV CDRH regulations when assembled into a functioning system. Perfect for engraving, cutting and drilling most materials. Only three available. We don't expect any more.

Limited Qty...100+Watts.....$1475., 60Watts...$1095., 35Watts.....$895.

SONY, ROBOTIC, COLOR CONFERENCE CAMERA, 450Line, 8X, NTSC & Y/C OUT, Serial Control of Pan, Tilt, Zoom, Auto Iris and Auto Focus too!

Like having your own R2D2. Intended for use in fortune 500 board rooms. The video performance is stunning. Superior to almost anything we have seen. Camera and lens is an integral assembly. Excellent Condition. Rugged black ABS enclosure. 8 pin mini-DIN & Std. SVHS jack. Size: 8"Dx6.5"H. Data on using the serial port is provided. The units self test on power up and the video is active. Reg price over $4K. **SPECIAL PRICE....$249ea.**

NEW, 2.4GHz VIDEO + STEREO AUDIO TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.

Originally sold for $500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tiliting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. (1" to infinity, macro capable) Auto power off when the privacy shutter is closed. Power is 7-13VDC (all pwr. adapters and cables included) 1/3" CCD, 330Lines res. 35% better than standard VHS! Can als be used to transmit VCR oputput to another TV for remote viewing. **SONY-ASTROVIEW COMBO..$189ea. or 2/$339**

2.4GHz TRANSMITTER & RECEIVER..........$129 pair.
SONY COLOR CAMERA with AUDIO........$69ea.

NEW, "COLOR STEALTH CAM", MICRO SIZE, with AUDIO!

That's right! COLOR! In the same size package too! Sleek aluminum housing fits like a glove! Removeable mtg. bracket & a 1.3M cable with BNC vid., RCA aud., (internal mic) & DC pwr. jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "COLOR STEALTH CAM"

- 1/3" • 350 Lines
- Auto Shutter
- 270k pixels
- Focus:10mm to inf.
- 1<ounce!
- 0 .7 Lux • AGC
- Pwr. 6-12V @30mA
- Std. 7 mm, 56° FOV lens
- NTSC video
- Size: 31mm sq. x 28mm d.

GM-4000S-STD w/audio, SPECIAL...$89ea.

B & W "STEALTH CAM", MICRO SIZE, with AUDIO!

The sleek aluminum housing fits like a glove! Removeable mtg. bracket & a 1.3M cable with BNC vid., RCA aud., (internal mic) & DC pwr. jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM"•1/3" CCD •410 Lines•0.3 Lux• AGC•Auto Shutter• Pwr. 12V @110mA•250k pixels•Std. 4mm, 78° FOV lens•Pinhole, 90° FOV• Focus:10mm to inf.•NTSC video•<ounce!•IR SENSITIVE•Size Std: 30mm sq. x 29mm d PH: 16mm d. Don't confuse with LOW RES., HIGH LUX C-MOS CAMERAS.

GM-2000S-STANDARD OR PINHOLE, with audio, SPECIAL...$69ea.

NEWPORT TRANSLATION STAGES.

MODEL:	DESCRIPTION:	EACH
605-4	With differential Mic.	$849
605-4	With Screw Adjust	$449
600A-3	W/Micrometer Adj.	$159
270	LAB JACK	$249
RSA-2T	360 deg. Rotary Stage	$129
625A-4	Laser Holder	$149
481A	Rotary Stage	$189
M36	Translation Stage	$249
460A-XY	X-Y Translation Stage	$189
460A-XYZ	X-Y-Z Translation Stage	$299
M37	3 Axis Trans. Stage	$289
415	Vertical Trans. Stage	$129
M360-90	Mnting. Plate 90deg.	$ 29
M436	Translation Stage	$199
M150	Magnetic Mtg. Base	$129
420	Linear Trans. Stage	$119
CYM-2	Square mnt. (Screw)	$ 99
13270	ORIEL Adj. IRIS	$ 99

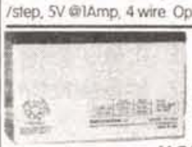
10V @ 2.5 AH SEALED, LEAD ACID, PACK. Each pack has 5, 2 Volt cells. 'D'size cells are arrainged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Perfect for high drain applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D

SALE! 6-five packs for $20, 40 for $99

MOTORIZED LINEAR SLIDE, offers 0.001" per step travel.

A THK, LWL-12 series re-circulationg, ball bearing slide with a 4.7" long steel rail is mounted to a 0.2" thick, black anodized, aluminum plate. The slide has a right angle bracket attached to a spring loaded, anti backlash, drive nut. Riding on a 0.37"diam. 10TPI lead screw which is coupled to one end of a dual 1/4" shaft , stepper motor with specs: 1.8° /step, 5V @1Amp, 4 wire. Optical end of travel sensor. **LWL12-2.5........$59ea.**

6V@12AH SEALED, RECHARGEABLE, BATTERY



New Panasonic, LCR6V12P1. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9"L x 3.7"H x 1.9"D **2 for $20, or 10 for $89**

MOTORIZED ZOOM LENS SPECIAL
6X magnification, 12X on a 1/3" camera! Auto iris too!

New, fabulous hi-res. optics with std. C-Mount. Superior Fujinon and Vicon lenses. Normally cost from $600 to $1500. There is no substitute for a good lens! All drive motors will operate from 6-12VDC. Auto iris has a built in amp which works with any cameras video output for control.

Type B-6, 12.5 to 75mm, 6X, f1.2 .... $179 or 2 for $349
ZOOM LENS CONTROLLER, NEW $169

END FIELD of VIEW GUESSWORK!
3.5 to 8mm VARI-FOCAL LENS

Brand New, super f1.8 lens allows you to smoothly adjust from a 97 °FOV @ 3.5mm to a 44° FOV @ 8mm. Now you can frame your area of interest just the way you want it! Standard CS-Mount with adjustable focus and iris. **SPECIAL.....$79ea. or 2 for $149**

NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN' (down 60 ft.) UNDERWATER B&W CAMERA with INTERNAL, INFRA-RED ILLUMINATOR!

Sleek black anodized, BRASS, housing. O-Ring sealed & WATERPROOF. Adjustable mount incl. Specs: 1/3" CCD, 400 Lines res., 0.05 Lux sensitivity, AGC, Auto Shutter. 12VDC @225mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25"diam. X 2" long. With 60 ft. cable. Perfect as a remote aresa inspection camera. Great for general outdoor use as well. **GM-300KIR.......$179**

NEW, GM960 TIME LAPSE VIDEO RECORDER

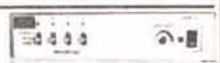
Finally a brand new, 4 head, T/L recorder with all the features at a price you can afford. Features: • Up to 960 hours on a standard T-120 VHS tape • 12 different modes for record and playback • Audio recording in the 12H and 24H mode. • 30Day memory backup • Easy mode setting • On- screen menus • Auto-Repeat recording mode • Serial or One-shot recording • Time, Date, speed, and Alarm indicators on screen. These deluxe units are front loading and are 14"W x 3.5"H x 12.2"D, 110VAC powered. **SPECIAL......$699ea. or 2 for $1349**

FUTABA, 2X20 VACUUM FLUORESCENT DISPLAY MODULE

New or like new, model M202SD series. Can directly replace LCD displays. The module includes the VFD, microcomputer and driver. Connects directly to the system bus. Display up to 40 dot matrix, 5 x 7 characters (222 characters and symbols), 5mm H x 3.5mm W with cursor. Display color is green at 505nm. Brightness is 690 cd/m² with four level dimming function. Weight: 5 oz. Size: 6.7"L x 2.6"H x 1" thick. Power required is 5VDC @ 350mA. Serial or parallel interface selectable. Perfect for any high visibility display requirement. With data. **SPECIAL FUTABA..........$15ea. 3 for $39**

DAYLIGHT/LOW LIGHT MINI CAM & A/I LENS, For down 'till dusk applications. Rugged alum. housing, dual mtg. sockets. 1/3" CCD, 420 lines res., 0.1 Lux sens., AGC, 12VDC @120mA. Take full advantage of camera sensitivity with super, 4mm, f1.4, 78° FOV Auto Iris lens included. BNC video out. 50mm sq. X 65mmL. With pwr. adapt. **SPECIAL, GM-510A/I...$189 or 2/$349**

NEW! 4 or 8 CHANNEL, SEQUENCER



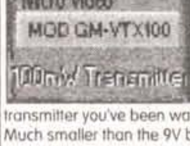
Model GM34 or GM38. Connect to any four standard video signals and they will be sequentially output to the dual rear panel BNC outputs. Front panel user adjustable, variable dwell 1 to 15 sec per channel. Auto or manual switching with channel bypass. Compact only 8.6"W x 3.7" D x 1.75" H, ac powered. Video loop through. **Special, GM-34..$69, GM-38..$89**

SUPER, MINI C-MOUNT CAMERAS, Super sensitive, GM410 or the general purpose GM412,

The GM-412 specs: B&W, size 1.5"sq. X 2.4"L, 250,000 Pixels, **380** Lines Resolution, Sensitivity **0.3** Lux. The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, **410** Lines Res., Sens. **0.05 LUX.**, Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform *ANY* camera in this magazine. Multi- lens options are available to exploit their superior performance.GM412 shown bottom. GM410 shown top.

GM412, less lens..$119,
GM410, less lens..$169

WORLDS SMALLEST ••• 100mW ••• VIDEO TRANSMITTER, ON SALE



Incredibly only 0.9" x 0.8" x 0.37" Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV Included. Perfect with our GM1000A. **SPECIAL TVX-100.....$159.**
TVX100 with GM1000A CAMERA....$209.

Please fax us your list of unique surplus material.

NEW, GEN III, INTENSIFIED GOGGLES, STATE of the ART, U.S. MADE.

The NQ5001, the world's most rugged and reliable, high performance night vision goggle for ground operations. Extensively used by the U.S. Army, it is the State-of-the-Art in mono-tube Night Vision Goggles. Utilizing the MX-10130 Gen III intensifier, it can be used in the darkest of conditions, headstrap mounted or handheld. Engineered for maximum comfort and simple to use. The system contains an IR illuminator, low battery indicator & high light sensor for automatic power off to image tube. Soft Case, headstrap, demist shields, sacraficial filter, eye cups, 2 AA batteries, and operators manual.

Specifications:	
Photocathode Gallium Arsenide	Battery Type 2 AA Life 20Hrs.
Resolution 45 lp/mm	Magnification 1x
Photo Response 1200 Ma/lu	Objective Lens 25mm F/1.2
Tube Gain 35,000x	Field Of View 40°
System Gain 3,200x	Focus Distance 2.5m To Infinity
Signal To Noise 18:1	Size 14.9 x 14.9 x 9.1 cm
	Weight 680 gm

Special....2995ea.

Write in 60 on Reader Service Card.

Events CALENDAR

The Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street addres for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:
Nuts & Volts Magazine
Events Calendar
430 Princeland Court
Corona, CA 92879
Phone 909-371-8497
Fax 909-371-3052
E-mail events@nutsvolts.com

JANUARY 2000

JANUARY 7-8

FL - GAINESVILLE - Hamfest. Alachua County Fairgrounds, SR-222 (3400 NE 39th Ave.), 1/2 mi. E. of SR-24 (Waldo Rd.). Talk-in: 146.820 (-). Gainesville ARS, Tom Scott KF4I, 352-378-9711 eves. E-Mail: k4gnv@arrl.net
Web: http://www.gars.net/hamfest/

JANUARY 8

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
CO - LOVELAND - Hamfest. Larimer County Fairgrounds, 700 Railroad Ave. 9am-3pm. VE exams. Talk-in: 145.115 (- offset, 100Hz) or 146.52. NCARC, Michael Robinson N7MR, 970-225-7051. E-Mail: michael@frii.com
Web: www.info2000.net/~ncarc
WI - WAUKESHA - Hamfest. Waukesha Co. Expo Center Forum. 8am-2pm. VE exams. West Allis RAC, Phil Gural W9NAW, 414-425-3649.

JANUARY 8-9

FL - FT. MYERS - Hamfest. Shady Oaks Community Center. Sat: 9am-3pm, Sun: 9am-2pm. Talk in: 146.880- and 147.345+. Ft. Myers ARC, Inc., Doug Douglas N8SAQ, 941-542-4741. E-Mail: douglas2@iline.com

JANUARY 9

IN - SOUTH BEND - Hamfest. Century Center, US33 N. & Jefferson Blvd. 8am-3pm. Talk-in: 145.290. Michiana Valley Hamfest Assn., Bob Denniston KA9WNR, 219-291-0252, M-F 7pm-10pm

JANUARY 15

AZ - GLENDALE - Hamfest. ARCA & ADAW, Mark Kesauer N7KKQ, 602-779-2722.
E-Mail: arcathill@aol.com
Web: http://www.phx-az.com/arca
LA - HAMMOND - Hamfest. South East LA ARC, Nathan Gifford N5BFC, 504-542-6798.
E-Mail: n5bfc@arrl.net
Web: http://www.selarc.org/selarchamfest.html
MI - FLUSHING - Hamfest. Amateur Radio & Youth, Clay Hewitt KF8UI, 810-233-7889.
E-Mail: clay@iavbbs.com
Web: http://www.qsl.net/aray/page6.html
MO - ST. JOSEPH - Hamfest. Ramada Inn, I-29 & Frederick Ave. (exit 47). 8am-3pm. FCC exams. Talk-in: 146.85 & 444.925. MO Valley & Ray-Clay ARCs, Kevin R. Phillips KC0AWM, 816-320-2129. E-Mail: KevinRPhillips@hotmail.com
Web: http://www.kc.net/~oconnor
NY - MARATHON - Hamfest. Skyline ARC, Patrick Dunn KC2BQZ, 315-468-5909. E-Mail: patdunn@dreamscape.com
OH - MIDDLETOWN - Hamfest. Dial Radio Club, Hank Greeb N8XX, 513-385-8363.
E-Mail: n8xx@arrl.net
Web: http://w3.one.net/~rkuns/swohdigi.html

JANUARY 15-16

FL - SARASOTA - Hamfest. Sarasota ARA, William Eddie Martin KI4ZJ, 941-954-1869.
E-Mail: ki4zj@msn.com
Web: http://www.saraclub.org

JANUARY 16

MI - HAZEL PARK - Hamfest. High School, 23400 Hughes St. 8am-2pm. Talk-in: 146.64 (-). HPARC, Tom Krausnick WC9F, E-Mail: wc9f@arrl.org Web: http://www.qsl.net/w8hp
NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146.910, 443.350 PL 156.7. Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053.
E-Mail: wb2slq@juno.com
Web: http://www.metro70cmnetwork.com
OH - NELSONVILLE - Hamfest. Sunday Creek AR Federation, Russ Ellis N8MWK, 740-767-2226.
E-Mail: scarf@hocking.edu
VA - RICHMOND - Frostfest. The Showplace, 3000 Mechanicsville Tpke. 8:30am-3:30pm. RATS, Jim Clark N3JJF, 804-739-2269 (Box 3378) or 804-271-1998. E-Mail: jim@compu data.net Web: http://frostfest.rats.net

JANUARY 22

FL - BROOKSVILLE - Hamfest. Hernando County Fairgrounds. 9am-4pm. Hernando County ARA, John Nedjedlo WB4NOD, 727-856-2568.
E-Mail: wb4nod@gate.net
Web: http://www.hcara.org
FL - PENSACOLA - Hamfest. University of West FL ARC, Ray Killough KE4UNR, 850-968-1048.
E-Mail: ke4unr@spydee.net
Web: http://qso.arc.uwf.org/~hamfest
MO - ST. CHARLES - Hamfest. St. Louis Repeater, Brad Ziegler KC0CDG, 314-569-5775.
E- Mail: kc0cdg@qsl.net or Jim Glasscock W0FF, 314-504-1104. E-Mail: kb0mwg@arrl.net
Web: http://www.listen.to/stlouisrepeater
NC - WINSTON-SALEM - Hamfest. Forsyth ARC, John Kippe N0KTY, 336-723-7388. Web: http://members.xoom.com/w4nc/hamfest.htm
NH - NASHUA - Hamfest. Res Ctr Church. NE Antique RC, 617-923-2665
TN - GALLATIN - Hamfest. Sumner County ARA, Roger Good KC4WPS, 615-451-0213.
E-Mail: hamfest@rogerg.com
Web: http://www.rogerg.com/scara

JANUARY 23

IL - CICERO - Hamfest. Wheaton Community Radio Amateurs, Don Motz N9NYX, 630-545-9950. E-Mail: hamfest2k@hotmail.com
Web: http://www.w9ccu.org
NY - BABYLON - Ham Radio University 2000. Town Hall Annex, Phelps Ln. 9am-3pm. Great South Bay ARC, Phil Lewis N2MUN, 516-226-0698. E-Mail: lewisp@hazeltine.com. Not a flea market or hamfest, no items for sale, solely for educational purposes.

JANUARY 29

AL - GREENVILLE - Hamfest. Butler County Fairgrounds. 8am-3pm. Talk-in: 146.67 or 145.19. Butler County & Pike County RACES, Jerry McCullough KE4ERO, 334-382-7644.
E-Mail: KE4ERO@alaweb.com
FL - ARCADIA - Hamfest. DeSoto ARC, Doug Christ KN4YT, 941-993-4834 or 941-494-5070.
E-Mail: kn4yt@cyberstreet.com
MO - SPRINGFIELD - Hamfest. Friends of Amateur Radio, Michael Blake N0NQW, 417-742-3955. E-Mail: mikewfpd@worldnet.att.net
NM - ALBUQUERQUE - Albuquerque Winter Tailgate Swapfest. Tom Ellis K5TEE, 505-291-8122. E-Mail: k5tee@arrl.net

JANUARY 30

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
MD - ODENTON - Hamfest. Vol. Fire Dept. Hall, 1425 Annapolis Rd. (Rt. 175). 8am-2pm. Free VE testing, pre-register 410-761-1423. Talk-in: 146.205/805. MD Mobileers ARC, Bill Hampton N3WGM, 410-766-2199.
E-Mail: diamondb@space4less.com
Web: www.space4less.com/usr/mmarc
OH - DOVER - Hamfest. Tusco ARC, Billy Harper KB8CQG, 330-484-4634.
E-Mail: bharper@neo.rr.com

FEBRUARY 2000

FEBRUARY 4-5

MS - JACKSON - State Convention. Jackson ARC, Ron Brown AB5WF, 601-982-0101 or 601-956-1448. E-Mail: ab5wf@arrl.net
Web: http://www.jxnarc.org

FEBRUARY 5

KS - LA CYGNE - Hamfest. Mine Creek ARC, Mike Eyman W0XM, 913-898-4695.
E-Mail: w0xm@arrl.net
MI - NEGAUNEE - Hamfest. Hiawatha ARA, Bill Beitel N8NRG, 906-226-2779.
E-Mail: n8nrg@portup.com
SC - NORTH CHARLESTON - Hamfest. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324. E-Mail: brycemyers@aol.com
Web: http://www.qsl.net/wa4usn/index.html

FEBRUARY 5-6

FL - MIAMI - Southeastern Division Convention. Fair Expo Center, 10901 SW 24th St. (Coral Way). Sat: 9am-5pm, Sun: 9am-4pm. Dade Radio Club, Evelyn Gauzens W4WYR, 305-642-4139.
E-Mail: w4wyr@bellsouth.net
Web: http://www.hamboree.org

FEBRUARY 7

AZ - PHOENIX - Hamfest. St. Clement of Rome Catholic Church Social Hall, 15800 Del Webb Blvd., Sun City. Talk-in: 147.30+. West Valley ARC, Fred Jones KC5AC, 623-214-7054.
E-Mail: kc5ac@arrl.net

FEBRUARY 11-12-13

FL - ORLANDO - State Convention. Orlando ARC, Ken Christenson KD4JQR, 407-291-2465.
E-Mail: KD4JQR@Juno.Com
Web: http://www.oarc.org/hamcat.html

FEBRUARY 12

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
NV - RENO - Hamfest. University of Nevada Radio Pack Club, Gary Grant K7VY, 775-784-6500 ext 276. E-Mail: k7vy@arrl.net

FEBRUARY 12-13

TN - MEMPHIS - State Convention. W. Ben Troughton KU4AW, 901-372-8031. E-Mail: bktrough@mem.net Web: http://www.dixiefest.org

FEBRUARY 13

OH - MANSFIELD - Hamfest. Richland County Fairgrounds. Talk-in: call W8WE 146.34/94. InterCity ARC, Inc., Pat Ackerman N8YOB, 419-589-7133

FEBRUARY 19

AR - RUSSELLVILLE - Hamfest. AR River Valley AR Foundation, Jonathan Setcer KC5BRY, 501-968-2938. E-Mail: hamfest@setcer.com
CA - MONTEREY - Hamfest. Naval Postgraduate School ARC, Will Costello WC6DX, 831-375-8133.
E-Mail: wc6dx@arrl.net
Web: http://www.k6ly.org/radiofest
MA - MARLBOROUGH - Hamfest. Algonquin ARC, Ann Weldon KA1PON, 508-481-4988
OR - RICKREALL - Hamfest. Polk County Fairgrounds, 520 S. Pacific Hwy. W. 9am-3pm. Talk-in:146.86-. Salem Repeater Association & The Oregon Coast Emergency Repeater, Inc., Evan Burroughs N7IFJ, 503-585-5924.
E-Mail: n7ifj@teleport.com Web: http://members.xoom.com/kb7cw/sra/index.html
PA - OBERLIN - Hamfest. Citizens Fire Co. VE Testing. Talk-in: W3UU 146.16/76. Harrisburg RAC, Dick Bordner N3NJB, 717-939-4825. E-Mail: N3NJB@aol.com Web: http://hrac.tripod.com
TX - SMITHVILLE - Hamfest. Bastrop County ARC, John Creamer W5QXH, 512-321-1145 or 512-321-1074. E-Mail: jsc@smithsys.net
Web: http://www.qsl.net/kb5yae

FEBRUARY 20

CO - BRIGHTON - Hamfest. Aurora Repeater Association, Wayne Heinen N0POH, 303-699-6335. E-Mail: n0ara@qsl.net
Web: http://www.qsl.net/n0ara
MI - FARMINGTON HILLS - Hamfest. William M. Costick Activities Center, 28600 Eleven Mile Rd. 8am-3pm. Talk-in: 145.350, 146.52 simplex. Livonia ARC, Neil Coffin WA8GWL, club phone 734-261-5486. E-Mail: swap@larc.mi.org
Web: www.larc.mi.org
NC - ELKIN - Hamfest. Briarpatch & Foot Hills ARCs, Glenn Diamond N4VL, 540-236-6514
NY - CHEEKTOWAGA - Greater Buffalo Winter Hamfest. Luke Calianno N2GDU, 716-634-4667 or 716-683-8880.
E-Mail: lcalianno@freewwweb.com
Web: http://hamgate1.sunyerie.edu/~larc
PA - CASTLE SHANNON - Hamfest. Wireless Association of South Hills ARC, Steve Lane W3SRL, 412-341-1043. E-Mail: w3srl@arrl.net
Web: http://www.hky.com/~sanfordb/index.htm

FEBRUARY 26

IN - LA PORTE - Hamfest. Civic Auditorium, 1001 Ridge. 7am-1pm. Talk-in: 146.520 simplex, 146.610 (131.8 PL). Neil Straub WZ9N, 219-324-

COMPUTER SHOWS

AGI Shows, 317-299-8827.
E-Mail: info@agishows.com
http://www.agishows.com

Blue Star Productions
612-788-1901.
http://www.supercomputersale.com

Computers And You, 734-283-1754.
www.a1-supercomputersales.com

Computer Central Shows
847-412-1900 & 1-888-296-6066.
E-Mail: compcent@megsinet.net
www.computercentralshows.com

Five Star Productions
810-379-3333. E-Mail: jeff@fivestar
www.fivestarshows.com

Georgia Mountain Productions
706-838-4827.
E-Mail: gamtnpro@blrg.tds.net
georgiamountain.com

Gibraltar Trade Center, Inc.
734-287-2000. Taylor, MI.
E-Mail: taylor@gibraltartrade.com
www.gibraltartrade.com

Gibraltar Trade Center, Inc.
810-465-6440. Mt. Clemens, MI.
E-Mail: mtclemens@gibraltartrade.com
www.gibraltartrade.com

KGP Productions
1-800-631-0062, 732-297-2526.
E-Mail: kgp@mail.com

MarketPro, Inc., 201-825-2229.
http://www.marketpro.com

MarketPro, Inc., 301-984-0880.
E-Mail: md@marketpro.com
http://marketpro.com

Narisaam Computer Show
770-663-0983.
E-Mail: narisaam@aol.com
Web: http://www.shownsale.com

Northern Computer Shows
978-744-8440.
E-Mail: inquiries@ncshows.com
Web: ncshows.com

Peter Trapp Computer Shows
603-272-5008.
Web: www.petertrapp.com

Events CALENDAR

7525. E-Mail: nstraub@niia.net
VT - MILTON - NVT Winter Hamfest. High School, Rt. 7. Mitch Stern W1SJ, 802-879-6589. E-Mail: w1sj@arrl.net Web: http://www.ranv.together.com

FEBRUARY 27

FL - ZEPHYRHILLS - Hamfest. Zephyrhills ARC, Ernie Vanselow KD4VRV, 813-783-8389
E-Mail: kd4vrv@gte.net
NY - HICKSVILLE - Hamfest. Levittown Hall, 201 Levittown Pkwy. 9am-2pm. Talk-in: W2VL, 146.85 repeater (136.5 PL). Long Island Mobile ARC, Eddie Muro KC2AYC, 516-791-7630. E-Mail: ham fest@limarc.org Web: http://www.limarc.org
VA - ANNANDALE - Hamfest. Vienna Wireless Society, Mike Toia K3MT, 703-757-7021.
E-Mail: k3mt@erols.com
Web: http://www.erols.com/k3mt/vws

MARCH 2000

MARCH 4

KY - CAVE CITY - Hamfest. Mammoth Cave ARC, Larry Brumett KN4IV, 270-651-2363.
E-Mail: lbrumett@glasgow-ky.com
Web: http://www.scrtc.blue.net/mcarc
NJ - PARSIPPANY - Hamfest. PAL Bldg., 33 Baldwin Rd. Splitrock ARA, Peter Glenn KC2KI, 888-511-SARA or 973-442-7379.
E-Mail: KC2KI@qsl.net
Web: http://www.ham.hsix.com/sara

MARCH 4-5

FL - NEW PORT RICHEY - Hamfest. Gulf Coast ARC, Rickie Brown KF4GXS, 727-863-1457. E-Mail: richar@gte.net. Don KK4VK, 727-848-8000.
Web: http://homel.gte.net/koerner/gcarc.htm

MARCH 5

NY - LINDENHURST - Hamfest. GSBARC & SCRC, Lenore Dunlop N2KYP, 516-785-0826. E-Mail: info@gsbarc.org Web: http://www.gsbarc.org

MARCH 10-11

NE - NORFOLK - State Convention. Elkhorn Valley ARC, Fred Wiebelhaus N0VLX, 402-379-1929. E-Mail: dfwiebel@sufia.net

MARCH 11

AZ - SCOTTSDALE - Hamfest. Scottsdale ARC, Roger Cahoon KB7ZWI, 602-943-7651
CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
ND - WEST FARGO - Hamfest. Red River Valley Fairgrounds. 8am-3pm. AR license testing. Talk-in: 146.76-. Red River Radio Amateurs, Mark Kerkvliet KG0FR, 701-282-4716. Web: http://www.rrra.org
WA - PUYALLUP - Hamfest. Mike & Key ARC, Michael Dinkelman N7WA, 253-631-3756 or 425-867-4797. E-Mail: mwdink@eskimo.com

MARCH 11-12

LA - RAYNE - Hamfest. Rayne Civic Center. AARA. Al Oubre K5DPG, 318-367-3901.
E-Mail: k5dpg@arrl.net
Web: http://www.acadian.net/w5ddl/
NC - CHARLOTTE - Charlotte Hamfest and Computerfair. Charlotte Merchandise Mart, 2500 E. Independence Blvd. Mecklenburg Amateur Radio Society, Tom Hunt KA3VVJ, 704-948-7373 until 9pm EST. E-Mail: hamfest@w4bfb.org
Web: www.w4bfb.org

MARCH 12

PA - YORK - Hamfest. York County Area Vocational-Technical School. VE Testing. Talk-in: 146.97-. Keystone VHF Club, Dick Goodman WA3USG, 717-697-2490.
E-Mail: yorkfest@aol.com
Web: http://members.aol.com/yorkfest
WI - WAUKESHA - Hamfest. County Expo Center, N.1 W.24848 N. View Rd. 8am-2pm. Talk-in: 146.820 PL 127.3. SEWFARS ARC, John Breecher N9NWN, 414-835-7035

MARCH 17-18

GA - MARIETTA - Hamfest. Kennehoochee ARC, Charles Golsen N4TZM, 404-252-3303.
E-Mail: cgolsen@atlanta.com

MARCH 18

FL - STUART - Hamfest. Martin County ARA, Romund Madson KS4KM, 561-337-1841
NJ - NORTH HUNTERDON - Hamfest. Cherryville Repeater Assn., Marty Grozinski W2CG, 908-788-2644 or 908-730-2771.
E-Mail: w2cg@arrl.net
WV - CHARLESTON - Hamfest. Jimmie Hewlett WD8MKS, 304-768-1142

MARCH 18-19

TX - MIDLAND - West Texas ARRL Section Convention. Midland County Exhibit Bldg. Sat: 8am-5pm, Sun: 8am-2pm. VE Exams. Beverly Harwood KC5BNT, 915-686-1841. E-Mail: sham rock@apex2000.net, Web: http://www.lxnet/e dge/midswap.htm. Larry Nix N5TQU, E-Mail: oilman@lx.net Web: http://www.w5qgg.org

MARCH 19

IL - STERLING - Hamfest. Sterling High School Fieldhouse, 1608 4th Ave. Talk-in: 146.25/146.85 W9MEP. Sterling-Rock Falls ARS, Lloyd Sherman KB9APW, 815-336-2434. E-Mail: lsherman@essexl.com
OH - MAUMEE - Hamfest. Lucas County Recreation Center, 2901 Key St. 8am-2pm. Talk-in: 147.27+ or 442.85+. Toledo Mobile RA, Paul Hanslik, 419-385-5056.
Web: www.tmrahamradio.org

MARCH 24-25

OK - TULSA - West Gulf Division Convention. Green Country Hamfest Assn., Merlin Griffin WB5OSM, 918-622-2277.
E-Mail: megriffin@ionet.net
Web: http://www.greencountryhamfest.org

MARCH 25

OH - COALTON - Hamfest. Jackson County ARC, Edgar Dempsey KD8XL, 740-286-3239.
E-Mail: kd8xl@juno.com
WV - BECKLEY - Hamfest. Plateau ARA & Black Diamond RC, James Martin KC8JSZ, 304-465-1428. E-Mail: w373@ientone.net
Web: http://members.spree.com/sip1/plateau

MARCH 25-26

MD - TIMONIUM - Greater Baltimore Hamboree & Computerfest/MD State ARRL Convention. Timonium Fairgrounds, York Rd. Sat: 8am-5pm, Sun: 8am-4pm. VE Exams. Baltimore ARC, Sharon Dobson N3QQC, 410-HAM-FEST or 800-HAM-FEST. E-Mail: n3qqc@amsat.org
Web: http://www.gbhc.org

MARCH 26

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GRAYSLAKE - Hamfest. North Shore Radio Club, Jacob Fishman KF9ZF, 847-291-4160.
E-Mail: kf9zf@lightwriters.com
Web: http://www.ns9rc.org
OH - MADISON - Hamfest. Lake County ARA, Roxanne N8BC, 440-209-8953.
E-Mail: tbrown@ncweb.com

www.gatewayelex.com

(Electronically Speaking, Gateway's Got It!)

gateway

MAIL ORDERS CALL TOLL-FREE 1-800-669-5810

Write in 107 on Reader Service Card.

Events CALENDAR

APRIL 2000

APRIL 1

MO - LEBANON - Hamfest. Lebanon ARC, Micki Jensen KC0EEX, 417-588-2335.
E-Mail: mjensen@llion.org

TX - BRENHAM - Hamfest. Brenham ARC, Dan Lakenmacher N5UNU, 409-836-8739.
E-Mail: lindan@phoenix.net

APRIL 2

CT - SOUTHINGTON - Hamfest. Southington ARC, Chet Bacon KA1ILH, 860-628-9346.
E-Mail: chet@chetbacon.com
Web: http://www.chetbacon.com/sara.html

NC - KINSTON - Hamfest. Down East Hamfest Assn., Doug Burt W4OFO, 252-524-5724

APRIL 7-8

WI - MILWAUKEE - Hamfest. Amateur Electronic Supply, Ray Grenier K9KHW, 414-358-4088.
E-Mail: rayk9khw@aol.com
Web: http://www.aes/jam.com

APRIL 8

AR - FORT SMITH - Hamfest. Fort Smith Area ARC, Kelsey Mikel KK5KU, 501-651-7003. E-Mail: kk5ku@amsat.org Web: http://www.qsl.net/fsaarc

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

MN - ROCHESTER - Hamfest. Rochester ARC, John Scott N0HZN, 507-285-6522.
E-Mail: n0hzn@aol.com
Web: http://members.aol.com/rarchams

NH - TWIN MOUNTAIN - Hamfest. North County ARC and LARK, Richard Force WB1ASL, 603-788-4428. E-Mail: bhabooks@together.net

TN - CLINTON - Hamfest. Oak Ridge ARC, David Bower K4PZT, 865-690-8360. E-Mail: d.bower@ieee.org Web: http://www.korrnet.org/orarc

WA - SPOKANE - Hamfest. Lilac City ARC, Warren Kelsey KJ7BB, 509-534-8443

APRIL 9

NC - RALEIGH - State Convention. Raleigh ARC, Chuck Littlewood K4HF, 919-872-6555.
E-Mail: k4hf@arrl.net Web: http://www.rars.org

PA - MONROEVILLE - Hamfest. Two Rivers ARC, Michael Kowalcheck KV3L, 412-751-9657. E-Mail: w3oc@nb.net Web: http://www.qsl.net/w3oc

WI - STOUGHTON - Hamfest. Madison Area Repeater Assn., Paul Toussaint N9VWH, 608-245-8890. E-Mail: n9vwh@arrl.net

APRIL 14-15-16

CA - VISALIA - International DX Convention. Southern CA DX Club, Cathy Gardenias KF6LFB, 909-862-0720. E-Mail: wu6d@dreamsoft.com
Web: http://www.scdxc.org

APRIL 15

AL - ALBERTVILLE - Hamfest. Marshall County ARC, Buddy Smith KC4URL, 256-593-2516.
E-Mail: kc4url@airnet.net

MN - BLAINE - Hamfest. Robbinsdale ARC, Harriet Johanson KB0UPG, 612-474-7346

NC - MORGANTON - Hamfest. Tom Taylor KC4QPR, 828-433-6205. E-Mail: kc4qpr@vistatech.net Web: http://www.wp.cc.nc.us/~cvhamfest/

APRIL 16

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

MI - GROSSE POINTE - Hamfest. South Eastern MI ARA, Jerry Rosner N8FGK, 313-331-3336.
E-Mail: n8fgk@amsat.org
Web: http://members.home.net/semara

APRIL 21-22

AR - LITTLE ROCK - Little Rock Hamfest, Jim Blackmon K5VZ, 870-246-7833 (h) or 870-246-6734 (w). Fax: 870-246-6736.
E-Mail: lrhamfest@usa.net
Web: http://www.aristotle.net/~ares/hamfest/

APRIL 22

ID - IDAHO FALLS - Hamfest. Eastern ID UHF Society, Jay Greenberg WA4VRV, 208-524-1388 or 208-526-7033. E-Mail: wa4vrv@srv.net
Web: http://www.srv.net/~wa4vrv/hamfest.htm

NH - NASHUA - Hamfest. Res Ctr Church. NE Antique RC 617-923-2665

APRIL 29

AL - MOULTON - Hamfest. Bankhead ARC, Rex Free KN4CI, 256-905-0822.
Web: http://www.homestead.com/n4idx

IA - DES MOINES - Hamfest. Des Moines RAA, Duane Bower WB0UCY, 515-287-6542.
E-Mail: duaneab@uswest.net

IL - STICKNEY - Hamfest. DuPage ARC, Ed Weinstein WD9AYR, 630-985-9256. E-Mail: DARCHamfest@aol.com
Web: http://www.qsl.net/dupagearc

APRIL 30

IL - ARTHUR - Hamfest. Moultrie ARK, Ralph Zancha WC9V, 217-873-5287.
E-Mail: rzancha@one-eleven.net

MAY 2000

MAY 6

AZ - SIERRA VISTA - Hamfest. Cochise ARA, Raymond Berger W1LYT, 520-378-4214

WI - CEDARBURG - Hamfest. Ozaukee RC, Joe Holly AA9HR, 262-377-2137; E-Mail: aa9hr@execpc.com. Skip Douglas, 262-284-3271

MAY 6-7

AL - BIRMINGHAM - Hamfest. Glenn Glass KE4YZK, 205-681-5019.
E-Mail: ke4yzk@bellsouth.net Web: http://www.bro.net/barc/slideshow/index.html

MAY 7

MD - HAGERSTOWN - Hamfest. Antietam Radio Assn., Tina Jones KB8ZQM, 304-728-7769.
E-Mail: kb8zqm@intrepid.net
Web: http://www.qsl.net/w3cwc

NY - YONKERS - Flea Market. Lincoln High School, Kneeland Ave. 9am-3pm. VE Exams. Talk-in: 440.425 PL 156.7, 223.760 PL 67.0, 146.910, 443.350 PL 156.7. Metro 70cm Network, Otto Supliski WB2SLQ, 914-969-1053.
E-Mail: wb2slq@juno.com
Web: http://www.metro70cmnetwork.com

PA - WRIGHTSTOWN - Hamfest. Warminster ARC, Roy Conners K3TEN, 215-947-9373.
E-Mail: k3ten@arrl.net
Web: http://www.voicenet.com/~k3dn

MAY 12-13

NH - ROCHESTER - Hamfest. Fairgrounds. Hoss Traders, Joe, 207-469-3492

MAY 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

MAY 19-20-21

OH - DAYTON - ARRL National Convention. Dayton ARA, Dave Coons, WT8W, 937-849-0604.

RAMSEY **Cool Wireless Goodies**

World's Smallest TV Transmitters

We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air! These are the units that are being built into hats, pagers, cigarette packs and sold for big $$!!

C-2000, Basic Video Transmitter..............$89.95 C-3000, Basic Video & Audio Transmitter.............$149.95
C-2001, High Power Video Transmitter...$179.95 C-3001, High Power Video & Audio Transmitter....$229.95

Doppler Direction Finder

Track down jammers and hidden transmitters with ease! This is the famous WA2EBY DF'er featured in April 99 QST. Shows direct bearing to transmitter on compass style LED display, easy to hook up to any FM receiver. The transmitter - the object of your DF'ing - need not be FM, it can be AM, FM or CW. Easily connects to receiver's speaker jack and antenna, unit runs on 12 VDC. We even include 4 handy home-brew "mag mount" antennas and cable for quick set up and operation! Whips can be cut and optimized for any frequency from 130-1000 MHz. Track down that jammer, win that fox hunt, zero in on that downed Cessna - this is an easy to build, reliable kit that compares most favorably to commercial units costing upwards of $1000.00! This is a neat kit!!

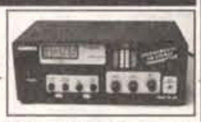
DDF-1, Doppler Direction Finder Kit $149.95

CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infra-Red) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens $69.95
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens....... $69.95
CCDCC-1, Color CCD Camera, wide-angle lens $129.95
IR-1, IR Illuminator Kit for B&W cameras $24.95
IB-1, Interface Board Kit............................ $14.95

Super Pro FM Stereo Transmitter



Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. *We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.*

FM-100, Pro FM Stereo Transmitter Kit $249.95
FM-100WT, Fully Wired High Power FM-100..... $399.95

FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strapable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.

FM-25, Synthesized Stereo Transmitter Kit $129.95

Lower cost alternative to our high performance transmitters. Great value, easily tunable, fun to build. Manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or 5 to 15 VDC. Add our matching case and whip antenna set for nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit..... $34.95
CFM, Matching Case and Antenna Set $14.95
FMAC, 12 Volt DC Wall Plug Adapter........... $9.95

Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

AR-1, Airband 108-136 MHz Kit $29.95
HFRC-1, WWV 10 MHz (crystal controlled) Kit $34.95
FR-1, FM Broadcast Band 88-108 MHz Kit............... $24.95
FR-6, 6 Meter FM Ham Band Kit $34.95
FR-10, 10 Meter FM Ham Band Kit...................... $34.95
FR-146, 2 Meter FM Ham Band Kit...................... $34.95
FR-220, 220 MHz FM Ham Band Kit...................... $34.95
SR-1, Shortwave 4-11 MHz Band Kit $29.95
Matching Case Set (specify for which kit) $14.95

Tiny Transmitters

Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger, more powerful, runs on 5-12 volts, goes up to a mile. FM4,5 operate in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & loose a part!

FM-4MC, High Power FM Transmitter Kit $17.95
FM-5, World's Smallest FM Transmitter Kit........ $19.95
FM-6, Crystal Controlled 2M FM Transmitter Kit ... $39.95
FM-6, Fully Wired & Tested 2M FM Transmitter $69.95

FM Station Antennas

For maximum performance, a good antenna is needed. Choose our very popular dipole kit or the Comet, a factory made 5/8 wave colinear model with 3.4 dB gain. Both work great with any FM receiver or transmitter.

TM-100, FM Antenna Kit $39.95
FMA-200, Vertical Antenna $114.95

RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.

LPA-1, Power Booster Amplifier Kit $39.95
CLPA, Matching Case Set for LPA-1 Kit $14.95
LPA-1WT, Fully Wired LPA-1 with Case........... $99.95

Touch-Tone Reader

Read touch-tone numbers from any radio, phone line, tape recorder - any audio source! Decipher called numbers on scanners, radio shows, anywhere touch-tones are used. Memory stores up to 256 digits, an 8 digit display window scrolls anywhere in memory. Memory good for 100 years, even with power off! Runs on 7 to 15 volt DC, Available in kit form with optional matching case set or fully assembled in case set. We sell tons of these to private investigators!

TG-1, Tone-Grabber Touch Tone Reader Kit.............. $99.95
CTG, Case for Tone-Grabber Touch Tone Reader $14.95
TG-1WT, Tone-Grabber, fully assembled with case $149.95
AC12-5, 12 Volt DC Wall Plug Adapter $9.95

AM Radio Transmitter

Operates in standard AM broadcast band. Pro version, AM-25, is synthesized for stable, no-drift frequency and is setable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 is tunable, runs FCC maximum 100 mw, range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set that dresses up the unit. Great sound, easy to build - you can be on the air in an evening!

AM-25, Professional AM Transmitter Kit $129.95
AM-1, Entry level AM Radio Transmitter Kit....... $29.95
CAM, Matching Case Set for AM-1.............. $14.95

Dinky Radios

Everyone who sees one of these babies says they just gotta have one! Super cute, tiny (that's a Quarter in the picture!) FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. The crystal clear sound will amaze you! Makes a great gift.

MFMT-1, World's Smallest FM Radio............ $11.95
PFMR-1, Pager Style LCD Clock & FM Radio $12.95

Order Toll-free: 800-446-2295

Sorry, no tech info, or order status at 800 number

For Technical Info, Order Status Call Factory direct: 716-924-4560

RAMSEY ELECTRONICS, INC.
793 Canning Parkway Victor, NY 14564

See our complete catalog and order on-line with our secure server at:
www.ramseyelectronics.com

VISA MasterCard AMERICAN EXPRESS DISCOVER

ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add $6.95 for shipping, handling and insurance. Orders under $20, add $3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

Write in 108 on Reader Service Card.

Events CALENDAR

E-Mail: wt8w@arrl.org
Web: http://www.hamvention.org

MAY 21

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

MAY 27-28

WY - CASPER - State Convention. Casper ARC, Warren (Rev) Morton WS7W, 307-235-2799 or 307-237-9301. E-Mail: mortonwg@aol.com Web: http://w3.trib.com/~carc/hamfest.html

JUNE 2000

JUNE 2-3-4

NY - ROCHESTER - Atlantic Division ARRL Convention. Harold Smith K2HC, 716-424-7184. E-Mail: rochfst@frontiernet.net Web: http://www.rochesterhamfest.org

JUNE 3-4

OR - SEASIDE - Northwestern Division ARRL Convention. Convention Center. VE testing. Talk-in: 146.660 (-600). SEAPAC, Randy Stimson KZ7T, 503-297-1175. Web: www.seapac.org

JUNE 4

IL - PRINCETON - Hamfest. Starved Rock Radio Club, Alan Erbrederis N9PIB, 815-498-9675. E-Mail: w9mks@arrl.net Web: http://www.qsl.net/w9mks

VA - MANASSAS - Hamfest. Ole Virginia Hams ARC, Jack McDermott N4YIC, 703-335-9139. E-Mail: N4YIC@arrl.net or patnjack@erols.com Web: http://www.qsl.net/olevahams/

JUNE 10

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

NC - WINSTON-SALEM - Hamfest. Forsyth ARC, John Kippe N0KTY, 336-723-7388. Web: http://members.xoom.com/w4nc/hamfest.htm

PA - BLOOMSBURG - Eastern PA Section Convention. Columbia-Montour ARC, George Law N3KYZ, 570-784-2299. E-Mail: n3kyz@epix.net Web: http://www.bafn.org/~cmarc

JUNE 11

IL - WHEATON - Hamfest. Six Meter Club of Chicago, Joseph Gutwein WA9RIJ, 630-963-4922 or 708-442-4961. E-Mail: wa9rij@mc.net Web: http://cyberconnect.com/orion/smcc.html

TN - KNOXVILLE - Hamfest. RAC of Knoxville, David Bower K4PZT, 423-670-1503. E-Mail: rack@kormet.org Web: http://www.kormet.org/rack

JUNE 18

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

JULY 2000

JULY 2

PA - WILKES-BARRE - Hamfest. Murgas ARC, Stanley Perry KE3TC, 570-735-2385. E-Mail: slperry@epix.net

JULY 7-8-9

UT - BRYCE CANYON - State Convention. UT Hamfest Committee, Kathy Rudnicki N7JSH, 801-547-9218. Web: http://www.utahhamfest.org

JULY 8

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

GA - GAINESVILLE - State Convention. Lanierland ARC, Ken Johnson NZ4Q, 706-335-9658. E-Mail: nz4q@aol.com

MO - KANSAS CITY - Hamfest. PHD ARA, Bob Roske WA0CLR, 816-436-0069. E-Mail: wa0clr@worldnet.att.net Web: http://members.tripod.com/~PHDARA/

JULY 9

IL - PEOTONE - Hamfest. Kankakee Area Radio Society, Don Kerouac K9NR, 815-939-7548. E-Mail: k9nr@juno.com Web: http://www.w9az.com

JULY 16

MA - CAMBRIDGE - Flea at MIT. Albany and Main Sts. 9am-2pm. Talk-in: 146.52 & 449.725/444.725 W1XM/R PL 114.8 (2A). Nick Altenbernd KA1MQX, 617-253-3776 (9-5). Web: http://web.mit.edu/w1mx/www/swapfest.html

MO - WASHINGTON - Hamfest. Zero Beaters ARC, Dave Neal N0PNG, 314-532-2477 (days) or 314-458-3254 (eve). E-Mail: Dave_Neal@msc.com Web: http://zbarc.usmo.com/

PA - KIMBERTON - Hamfest. Mid-Atlantic ARC, Bill Owen W3KRB, 610-325-3995. E-Mail: gem@op.net Web: http://www.marc.org/hamfest.html

JULY 22

NH - NASHUA - Hamfest. Res Ctr Church. NE Antique RC 617-923-2665

JULY 23

IL - SUGAR GROVE - Hamfest. Fox River Radio League, Maurice Schietecatte W9CEO, 815-786-2860. E-Mail: w9ceo@arrl.net Web: http://www.frrl.org/hamfest.html

JULY 29-30

OK - OKLAHOMA CITY - State Convention. Central OK Radio Amateurs, Harold Miller KB1ZQ, 405-672-7735 or 405-650-9963. E-Mail: n1lpn@swbell.net Web: http://www.geocities.com/heartland/7332

JULY 30

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

OH - RANDOLPH - Hamfest. Portage ARC, Joanne Solak KJ3O, 330-274-8240. E-Mail: ljsolak@apk.net Web: http://parc.portage.oh.us

AUGUST 2000

AUGUST 5

OH - COLUMBUS - Hamfest. Voice of Aladdin ARC, James Morton KB8KPJ, 614-846-7790. E-Mail: kb8kpj@cs.com

AUGUST 12

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

IL - QUINCY - Hamfest. Western Illinois ARC, Jim Funk, N9JF, 217-336-4191. E-Mail: jfunk@adams.net Web: http://www.qsl.net/w9awe

AUGUST 13

IA - AMANA - Hamfest. Cedar Valley ARC, Chuck Bassett N0UTS, 319-378-0448. E-Mail: n0uts@rf.org Web: http://cvarc.rf.org

Write in 109 on Reader Service Card.

CALL TOLL FREE
(800) 292-7711
Orders Only
Se Habla Español

C&S SALES

Secure On-line Ordering @ cs-sales.com

CALL OR WRITE FOR OUR FREE 64 PAGE CATALOG!
(800) 445-3201

Digital Multimeters

Elenco Model M-1740 $39.95

11 Functions:
- Freq. to 20MHz
- Cap. to 20μF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs.

Model M-2760 - $24.95 (9 functions)

Elenco Model LCR-1810 $99.95

- Capacitance .1pF to 20μF
- Inductance 1μH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

Fluke 87III $319

Features high performance AC/DC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement.

CCTV Cameras

Cameras have 420 lines (360 color) of resolution, 0.08 Lux, 3.6mm/F2 90° field of view. Power requirement is 12VDC @ 100mA (order SC-1).

MONOCHROME CAMERAS

SC-12 - 35mm Lens (1.25"x1.25") $69
SC-15 - Pin Lens (1.25"x1.25") $69
Add $10 for lens • Add $10 for audio

Accessories:
SC-1 - 12V 100mA adapter $6.
SC-2 - 50' cable with connectors $19.

COLOR CAMERAS

SC-20 Pin Lens
SC-21 3.6mm Lens
360 Lines 1.25" x 1.25"
Infrared Sensitive, Audio Included
$109
Add $10 for case
Call for complete catalog.

Quantity Discounts Available

Test Equipment

Elenco Sweep Function Generator with built-in frequency counter Model GF-8036 $229.95

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

10 Function 1.3GHz Universal Counter Elenco Model F-1300 $229.95

- Frequency .05Hz - 1.3GHz 3 Ranges
- Period - Can read 60Hz to 60.000000 F=1/T
- Totalize - Counts to 199,999,999
- RPM - 3 to 2099994 RPM
- Duty Cycle
- Max/Min/AVG with Time
- Stop-watch set .2 sec. to 100 hrs.
- Math Functions
- Timer - 2 sec. to 99 days
- Pulse Width - 0.1ms to 66666.6ms

20MHz Sweep / Function Generator with Frequency Counter Model 4040 $445

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

21.5MHz Model 4070 $1295
10MHz Model 4017 $325
5MHz Model 4011 $255

BK PRECISION

Elenco Handheld Universal Counter 1MHz - 2.8GHz Model F-2800 $99

Sensitivity:
- <1.5mV @ 100MHz
- <5mV @ 250MHz
- <5mV @ 1GHz
- <100mV @ 2.4GHz

Features 10 digit display, 16 segment and RF signal strength bargraph.
Includes antenna, NiCad battery, and AC adapter.

B&K Frequency Counter Model BK-1875 50Hz - 2.8GHz 3 Channels $189

Sensitivity:
- <0.8mV @ 100MHz
- <6mV @ 300MHz
- <7mV @ 1GHz
- <100mV @ 3GHz

Ultra sensitive synchronous detector bargraph and RF strength.

Elenco Quad Power Supply Model XP-581 $85

4 Fully Regulated DC Power Supplies in One Unit

4 DC voltages:
3 fixed: +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable: 2.5 - 20V @ 2A

B&K Video Monitor Tester Model 1275 $169

Great handheld unit to test PC and Mac monitors. The model 1275 is ideal for the field or the service bench. Small, portable and very effective, the 1275 generates crosshatch, dots, color bars and raster patterns in green, blue, red, black and white.

Soldering Station

Weller Low Cost Soldering Iron Model WLC-100

- Variable power control produces 5-40 watts.
- Ideal for hobbyists, DIYers and students.
- Complete with 40W iron.

$34.95

Elenco Oscilloscopes

Free Dust Cover and 2 Probes

UL

S-1325	25MHz	Dual Trace	$325
S-1330	25MHz	Delayed Sweep	$439
S-1340	40MHz	Dual Trace	$475
S-1345	40MHz	Delayed Sweep	$569
S-1360	60MHz	Delayed Sweep	$749
S-1390	100MHz	Delayed Sweep	$995

DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	$695
DS-303	40MHz/20Ms/s Analog/Digital	$995
DS-603	60MHz/20Ms/s Analog/Digital	$1295

Tekk Radios

Pro-Sport FRS Two-Way Radio Model PRO-SPORT+

Talk up to 2 miles!
Available in Yellow, Blue & Black
No License Required

- 1/2 Watt Output, 14 Channels.
- TX & RX LED/LCD Indicators.
- Large LCD Display.
- 38 Privacy (CTCSS) Tones.
- Removeable Antenna.
- Water Resistant.
- 500mW Output.
- Palm Sized.

$69 each or $125 Set of 2

PRO SPORT Model $109.95 set of 2

PC Repair

A+ Certification Self-Study Course™ Model XK-305 $379

DOS/WIN Exam
DOS 6.2
Windows 3.1 Installation and Configuration
Windows 3.1 Application Support
Windows 3.1 Devices and Drivers
Windows 3.1 Networking and Troubleshooting
Windows 95 Installation and Deployment
Windows 95 Basic Configuration
Windows 95 Troubleshooting and Optimization

Includes all the technical material, knowledge and interactive exercises needed to pass the A+ exams and excel in the competitive PC repair marketplace.

Introduction to PC Repair Self-Study Course™ Model XK-301 $179

COURSE CONTENTS
Introduction to Computers
IBM PC's and Clones
PC Assembly/Disassembly
Introduction to MS-DOS
Introduction to Windows 3.1
Introduction to Windows 95
Introduction to Networks
Introduction to the Internet

Provides you with the easiest and most effective way to learn the fundamentals necessary for a profitable and successful career as a PC Repair Technician. Ideal for individuals new to the I.T. profession and as instruction prior to studying for A+ certification.

Elenco Technician Tool Kit Model TK-1500 $49.95

28 tools plus a DMM contained in a large flexible tool case with a handle ideal for everyone on the go.

Elenco Educational Kits

Model AR-2N6K 2 Meter / 6 Meter Amateur Radio Kit $34.95

Model AM-780K Two IC Radio Kit $11.95

Model AK-700 Pulse/Tone Telephone Kit $15.95

Model AK-870 Radio Control Car Kit $24.95
- Solderless
- 7 Functions
- Radio Control Included

Model M-1005K Digital Multimeter Kit $19.95
- 18 Ranges
- 3 1/2 Digit LCD
- Transistor Test
- Diode Test

Model XK-150 Digital / Analog Trainer $89.95

Guaranteed Lowest Prices
UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax
SEE US ON THE WEB → http://www.cs-sales.com

C&S SALES, INC.
150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710

15 DAY MONEY BACK GUARANTEE
2 YEAR FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Write in 65 on Reader Service Card.

Questions & Answers
TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts readers* and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and *NO GUARANTEES WHATSOEVER* are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 92879, OR fax to (909) 371-3052, OR E-Mail to **forum@nutsvolts.com**

I need any information available (hardware, software, programming) on HP 75D vintage laptop. Also accessories, printer, and mini-cassette.
1001 **David LaMoreaux**
Brecksville, OH

I'm driving a stepper motor with a UCN5804B stepper motor driver chip. The problem is, the stepper motor is mostly idle, but still gets very hot. Is there a MOSFET or another way to turn off the power to the motor when it isn't being directed to turn?
1002 **Greg Moran**
Riverside, CA

How can I tell the difference between a regulated and an unregulated 12-volt DC power supply? Can I power a VHF radio with a 12-volt automotive battery and simultaneously charge the battery with a 10 amp, 12-volt battery charger?
1003 **Portland, ME**

I am considering a purchase of a miniature color video camera, but I noticed that they only have about 410 lines horizontal scan. I believe broadcast TV uses 525. Why the difference and what will I lose at the lower scan rate?
1004 **Curt Powell**
Rocky Mount, NC

I have a generator that works fine, the only problem is that it is 110-volts DC at 100 amps. I need a diagram to build a converter to 60-cycles AC, about 2,000 watts.

Waveform is not important because I know how to take care of that problem.
1005 **Francis Hillibush**
Ringtown, PA

I would like information for DEC PC LPv/LPv+ computer, power supply voltages, and color codes.
1006 **R. H. Saunders**
Epping, NH

On my computer (COMPAQ PRESARIO 5715) when I go to MSDOS I get WINDOWS and in an attempt to find the revision level of the DOS in the computer, I can only get the revision level of WINDOWS. How do I find out the revision level of the DOS? I have a book on DOS and if I knew the REV then I would know if the book pertains to the level that I have.

I am a newbie to the PC world.
1007 **Donald Lambert**
Forsyth, IL

I have seen an interesting gadget (toy) for a PC that is called Intel Play QX3 Computer Microscope.

If it works like I think it does, it would make a wonderful basis for experimenting with. Has anybody done anything with the Intel Play QX3?

I'm thinking that it's like an eye (electronic of course) in which if you dismantled, the microscope could be hooked up to anything optical such as a telescope or other optical instrument. Or, is the resolution of the eye less than what will do that?
1008 **Donald Lambert**
Forsyth, IL

I need the pin readout on the plug of a GBC video camera. Lookout, LC2001.
1009 **Frank Bowen**
Fresno, CA

I am in need of a resistive heating element to use for igniting a hydrogen flame. I am currently using a model airplane glow plug but would like something with a higher temperature range.

I have heard that nichrome wire and platinum coatings are preferred as the platinum will act as a catalyst to sustain the burn at a much lower voltage. Where can I find information of such a device so that I may construct one?
10010 **Frank J. Prevatt**
via Internet

I am looking for a schematic which will allow a laptop computer, through the COM1 or LPT1 port to communicate with HPIB equipped electronic test equipment.
10011 **Jeffrey Shank**
York, PA

Does anyone have any information about a Lynx 500 hard drive tester? I need a manual.
10012 **Charles R. Wells**
Washington, MI

Does anyone have a schematic/service manual for a Zenith Model R476 AM/FM clock radio?
10013 **Ed Wetter**
Fremont, CA

I want to build an AC voltage conditioner. This would be a microprocessor controlled unit that would monitor the I/P voltage (household 120 VAC) and adjust the O/P to remain at 120 VAC if the I/P falls or rises.

There would also be spike/surge protection. Also, any other bells and whistles would be appreciated. I will be expecting to use this for a computer, so O/P current would only have to power a computer, monitor, cable modem, printer, and scanner at the most.
10014 **Jeff Strachan**
Keewatin, Ontario, Canada

I have a military transmitter made by Collins Model TCZ-2 Serial #36 dated 3/16/46. Where can I get information on this item? A schematic or operating manual is needed.
10015 **R. L. Delaney**
via Internet

I have an Electohome EH580 sound system with a blown amp. Does someone know where I could get schematics?
10016 **Colin Lohrer**
via Internet

ANSWERS

ANSWER TO #129915 - DEC. 1999
I have an older, color Mac scanner. Is it possible to convert it to PC?

Virtually all (pre-iMac) Mac scanners use the SCSI interface. In order to use it on your PC, you will need to find a SCSI card and the appropriate driver software. If the company marketed the scanner for both the Mac and PC, you should be able to find PC drivers on their web site. If not, a generic driver might work instead.
Tom Owad
Mount Wolf, PA

ANSWER TO #12991 - DEC. 1999
I enjoy listening to AM broadcast band DX on my portable AM/FM radio. Is there a simple way I can add an analog S-meter to it for AM reception only?

The simplest thing to do is measure the automatic gain control (AGC) voltage. It is derived from the AM detector diode, which should be easy to find.

The FM detector has two diodes. The AM detector usually has a bias voltage which may be positive or negative, depending on the design and

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of $25.00 will be sent if your answer is printed. Be sure to include your mailing address if responding by E-Mail.
- In most cases, only one answer per question will be printed.
- Your name, city, state, and E-Mail address, (if submitted by E-Mail), will be printed in the magazine, unless you notify us otherwise with your submission.
- The question number and a short summary of the original question will be printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

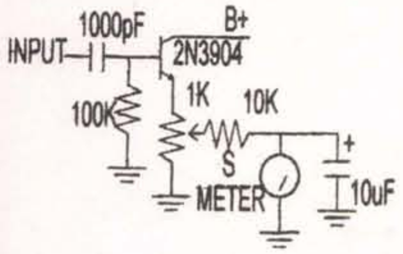
All questions should relate to one or more of the following:
1) Circuit Design 3) Problem Solving
2) Electronic Theory 4) Other Similar Topics

INFORMATION/RESTRICTIONS
- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS
- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

whether NPN or PNP transistors are used. The AGC voltage varies with signal strength, increasing in a positive direction if PNP transistors are used and in a negative direction if NPN transistors are used.

If the bias is a problem, causing the meter to read full scale at all times, this isolation circuit will work: Connect the input to the IF transformer terminal that feeds the detector diode. You may not need the 1K pot, but it allows you to adjust the sensitivity so it doesn't register on noise or overload on strong signals.



Russell Kincaid
Milford, NH

ANSWER TO #129912 - DEC. 1999

I read enthusiastically Nuts & Volts articles on NC routers because I was building one. It is complete now, but has a serious motor noise problem.

How can I quiet it down so the logic board will stop getting lost?

I am surprised you are having trouble with the logic board because its signals should be low impedance and have good noise immunity.

The first suspect would be ground noise, the motor could be causing IR drops in a common ground that couples into the logic. If you have completely isolated the motor wiring from the logic wiring, then ground noise is not the cause.

The second suspect is radiated noise, and there are many steps to reduce it. Commutation noise from the 60W motor would be the noise source. The two motor leads should run close together. The radiated magnetic noise depends not only on the motor current, but also on the effective area of the loop. Keeping the leads close together minimizes the area.

Ott (*Noise Reduction Techniques in Electronic Systems*) recommends putting ferrite beads on the motor leads. The beads should be close to the motor, and on the supply side of the beads, there should be a shunt capacitor.

The beads minimize the high frequency currents in the motor leads by adding resistance and reactance, and the shunt capacitor minimizes the radiation area for high frequency currents. Ott warns that these measures can make the problem worse if the the values are wrong — the capacitance and inductance may resonate with motor.

Adding a shield will also help, but if most of the noise is magnetic

Go Wireless With Our Modules

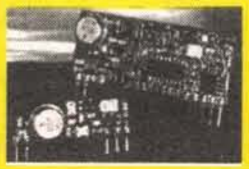
SILRX/TXM

SILRX — $26.00 ea.
TXM — $15.50 ea.

The TXM and SILRX modules are a transmitter and receiver pair which can achieve a one-way radio data link-up to a distance of 200m over open ground.

Both units are supplied in space-saving single-in-line packages and offer SAW controlled, wide band FM transmission/reception.

The modules are particularly suited to battery-powered, portable applications where low power and small size are critical design criteria.



TX2/RX2

TX2 — $19.50 ea.
RX2 — $38.50 ea.

The TX2 and RX2 radio transmitter and receiver pair enable the simple implementation of a data link at up to 40kbit/s at distances up to 75m in-building and 300m open ground. Both modules combine full screening with extensive internal filtering to ensure EMC compliance by minimizing spurious radiations and susceptibilities. The TX2 and RX2 modules will suit one-to-one and multinode wireless links in applications including car and building security, EPOS and inventory tracking, remote industrial process monitoring, and computer networking.

Because of their small size and low power requirements, both modules are ideal for use in portable, battery-powered applications such as hand-held terminals.

900 MHz AVAILABLE NOW

RPC

RPC — $99.00 ea.

The RPC module is an intelligent transceiver which enables a radio network link to be simply implemented between a number of digital devices. The module combines an RF circuit with processor-intensive low-level packet formatting and recovery functionality, requiring only a simple antenna and 5V supply to operate with a microcontroller or a PC.

BiM

BiM — $69.00 ea.

The BiM module integrates a low-power UHF FM transmitter and matching superhet receiver together with data recovery and TX/RX change over circuits to provide a low-cost solution to implementing a bi-directional short-range radio data link.

Lemos International Co., Inc.
65 Southbridge Street, Auburn, MA 01501
Phone (508) 798-5004 ♦ Fax (508) 798-4782
www.lemosint.com ♦ sales@lemosint.com
All products available in either 418 or 433 MHz

Write in 88 on Reader Service Card.

ANSWERS TO #129913 - DEC. 1999

Supposedly, stranded wire of a particular gauge is rated to carry more current than a solid wire of similar gauge (at DC or power line frequencies where skin effect is negligible).

1. Is it true that stranded wire has higher current carrying capability?

2. If the answer to question #1 is yes, why is this?

3. Does stranded wire of a particular gauge have more, less, or the same metallic crossectional area as its solid wire counterpart of a similar gauge?

#1 Stranded wire has the same current carrying capacity as solid wire. The stranding is chosen to have about the same cross sectional area, so the current densities and IR losses will be about the same.

Here are some wire sizes and common strandings (areas are in circular mils).

AWG	area	stranding	strand area	equivalent area
28	159	7x36	25	175
26	253	7x34	40	280
24	404	7x32	64	448
22	640	7x30	100	700
20	1024	7x28	159	1113
18	1624	16x30	100	1600
16	2581	26x30	100	2600

Solid wire is less expensive than stranded, so solid is preferred. House wiring uses solid wire in the walls because it is less expensive and will not move after installation. Power cords are stranded because they must be flexible. Thin wires are less springy and they can bend around smaller radii without work hardening (yielding). Too much work hardening will break a wire.

I don't think there is any current carrying advantage of stranded over solid wire, but here are some reasons why someone might think stranded has an advantage.

Although interior house wiring is usually solid, the service entrance wire (which might carry 200A) is usually stranded. The wire is probably stranded for a couple reasons. First, solid wire that thick is awkward to handle because it won't bend easily. Second, the wire will sway in the wind, so stranding eases the problems of work hardening.

At high frequencies (say 50 KHz to 2 MHz), Litz wire can have much lower loss than the equivalent solid wire. Although Litz wire is a stranded wire, it is unlike ordinary stranded wire. The individual strands are insulated from each other, and the strands are woven rather than just twisted together.

Gerald Roylance
Mountain View, CA

#2 My wire tables show that solid and stranded wire of a given AWG have the same area in circular mils and that stranded wire has slightly higher maximum resistance, so stranded should definitely not be used for more current than solid wire. It may be that solid wire will fuse (melt) before stranded, but that is not a good design criteria.

Russell Kincaid
Milford, NH

#3 On page 241 of Oliver Heaviside's *Electrical Papers*, volume 2, copyright 1894, states "inductance can be increased indefinitely by thinning the wire." My thoughts are, this might be partially mitigated by the fact so many of them are in parallel, and partially enhanced by mutual inductance. That would mean that stranded wire might have a higher AC impedance.

But, as far as pure resistance, a theory has been put forward in U.S. patent 4,325,795 on April 20, 1982 by Ronald C. Bourgoin that if you make a conductor narrow enough it will force electrons to pair up — I guess, causing their spin induced magnetic poles (opposite spins at the same energy level) to stick together — and the electricity through that conductor would become superconducting (no resistance).

In his patent, Bourgoin claims to have had positive results with molecularly thin Bismuth strands.

As far as regular sized stranded verses solid wire is concerned, there may be an increase in conductivity in stranded wire, caused by just a partial increase in pairings ups.

Greg Moran
Riverside, CA

#4 To easier understand why stranded wire can carry more current than its solid counterpart, please know that the stranded versions are made up of nothing more than several conductors of smaller standard gauges and, in order to match the stranded and solid to exactly the same size, manufacturers would have to make non-standard sizes of conductor strands, which would be uneconomical.

For instance, the circular mil area, (abbreviated cmil), of 22-gauge solid wire is 642.4, but the stranded version of common 22-gauge hookup wire is usually composed of seven strands of solid 30-gauge wire which has a cmil of 100.5 per strand. Now multiply 100.5 by 7 and you get a stranded conductor with a total cmil of 703.5, an additional 61.1 of cmil, which would be close to having an extra strand of 32-gauge wire added in.

Even though stranded wire will always carry at least the same amount or slightly more current than solid wire, the difference is practically negligible as a strand of 32 gauge wire can only carry about a 10th of an ampere without excessively overheating.

Kevin T. Kaas
New Port Richey, FL

(instead of electrostatic), then the shield should be steel rather than aluminum.

Gerald Roylance
Mountain View, CA

ANSWER TO #12999 - DEC. 1999

What are fusible resistors? How are they constructed and tested? How are they specified?

All resistors are fusible if you overload them. Fusible resistors are calibrated to open at a specified current.

The most popular these days are surface mount chip resistors. You can get more information at **www.belfuse.com** or **201-432-0463** and **www.wickmannusa.com** or **404-699-7820**.

There is another device called a Positive Temperature Coefficient resistor (PTC) that changes from a low resistance at room temperature to a very high resistance at a high temperature. This change is sudden, so it makes a nice resettable fuse. You can get more information at **www.bourns.com** or **909-781-5500**.

Russell Kincaid
Milford, NH

ANSWER TO #129910 - DEC. 1999

I read the article on "Reviving NiCad Powered Devices."

I used to build power supplies for reclaiming gold by electroplating and the major problem was "dendrites" growing between the plates and having them short out. We then switched to "periodic reverse" plating in which for gold it was about 90% plating followed by 10% deplating.

Could a NiCad charger be built using this technique to eliminate this problem?

Your observation is a good one, but it already happens. Charging a battery is like plating it, and using a battery runs the charging reactions in reverse — deplating the battery. So just using the battery accomplishes your goal. Just make sure you discharge your NiCd batteries once in awhile.

Keeping a NiCd battery topped up all the time limits its life.

Some NiCd battery systems (such as those in satellites) deliberately discharge a bank of cells to guarantee a periodic deep discharge. The purpose of the deep discharge may be to remove dendrites, but I do not know for sure. Although some batteries, like NiCd, work better with deep discharges, other batteries (such as lead-acid) do not like deep discharges.

Gerald Roylance
Mountain View, CA

ANSWER TO #10991 - OCT. 1999

I need a volume control circuit that could connect to the tape in/out jacks on my stereo for remote volume control. Or, a low-cost commercial unit to do this, perhaps infrared.

The DS1802 dual audio taper digital potentiometer from Dallas Semiconductor can be used to provide the volume control that Jim is looking for.

Figure 1 shows how to control volume up/down and balance using two push button-switches.

The DS1802 consists of two audio taper potentiometers with 65 steps of resistance. Each press of UC0 or UC1 will increase or decrease the resistance seen

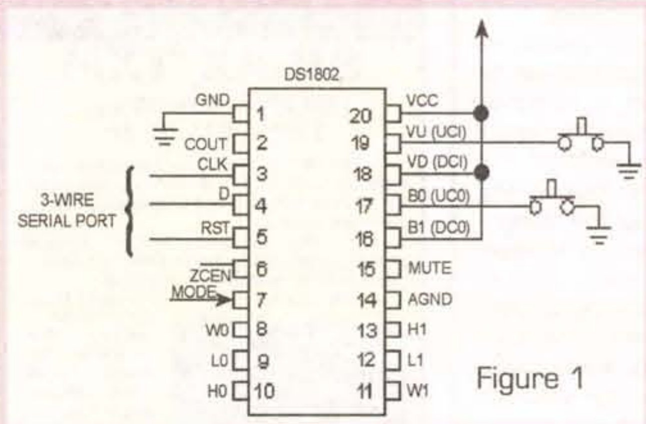
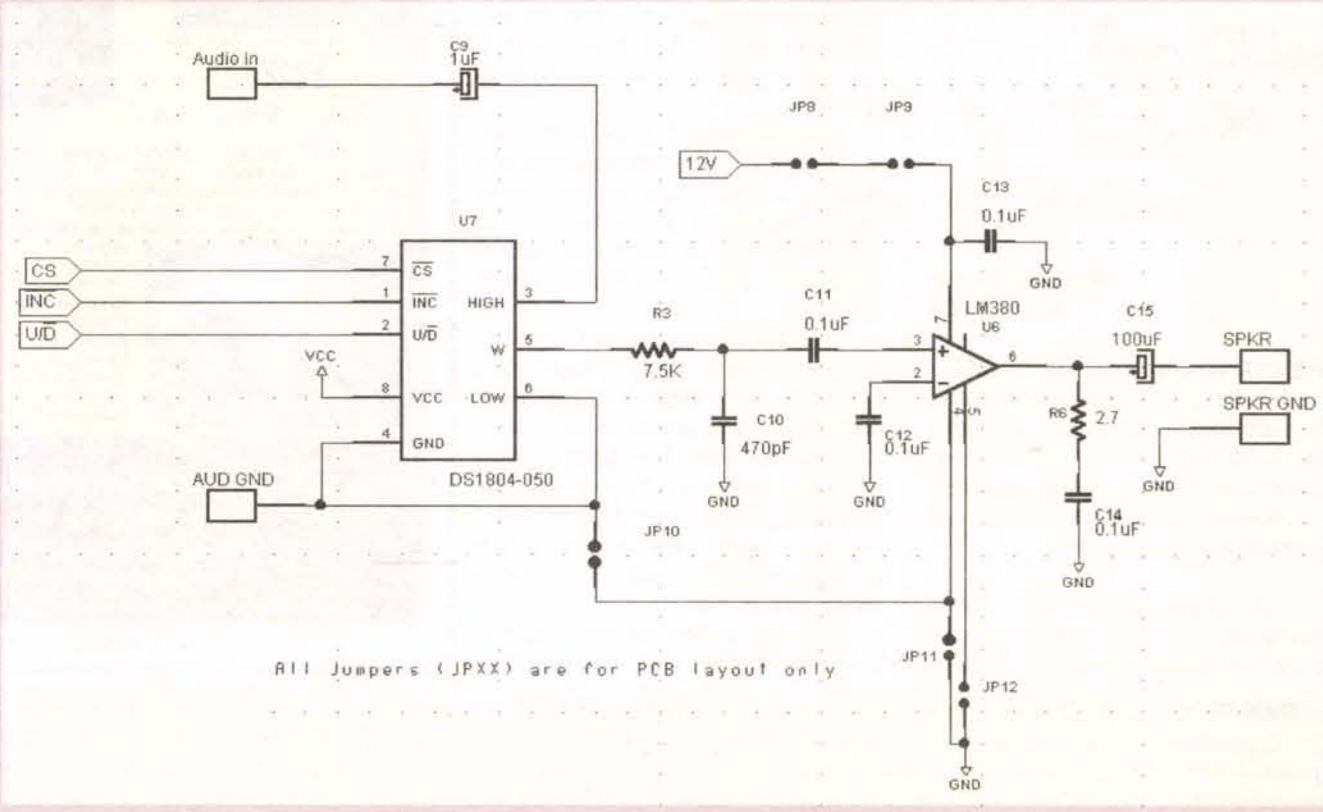


Figure 1



ANSWER TO #12996 - DEC. 1999

I would like to figure out how to make my door locks keyless. They are already electric, so some sort of transmitter is all that would be necessary.

Installing a remote keyless entry system is as easy as setting aside one Saturday morning, thanks to the number of add-on kits that are available today.

You can purchase a simple remote keyless entry system like the OMEGA AU-REC-8 from the Internet at www.partsexpress.com for around $70.00. If you would like to take a step up, for around $120.00, you can purchase a car alarm system, most of which come with the remote keyless entry as one of the standard

LASERS & ACCESSORIES

HELIUM NEON LASERS
- Complete Systems
- Plasma Tubes
- Power Supplies

ACCESSORIES
- Optics
- Electro-Optics
- IR Viewers
- Books & More

DIODE LASERS
- Visible / IR
- Complete Modules
- Collimating Optics
- Drive Circuits

FREE CATALOG
WEB SITE:
www.
mi-lasers.com

MEREDITH INSTRUMENTS

Phone: 623-934-9387 • Fax: 623-934-9482

Write in 89 on Reader Service Card.

$$ BEST DEALER PRICE & SERVICE $$

Converters:	10+	50+	100+
♦ **ViewMaster VM-3800** 125 Ch Plain Converter, PG Lock HRC/STD	$75	$70	Call
♦ **Panasonic TZPC-175** 99 Ch Plain Converter, PG Lock HRC/STD	$50	$45	Call
♦ **Centurion CF-3000** 99 Ch Plain Converter, PG Lock HRC/STD	$55	$50	Call
Remotes:			
♦ **Jerrold 400,450,550, CFT**	$4.95	$4.50	Call
♦ **SA 175,475, 8600**	$4.95	$4.50	Call
♦ **Zenith, Tocom, Pioneer**	$4.95	$4.50	Call

$$ TNT ELECTRONICS • (405) 692-4982 $$

Write in 90 on Reader Service Card.

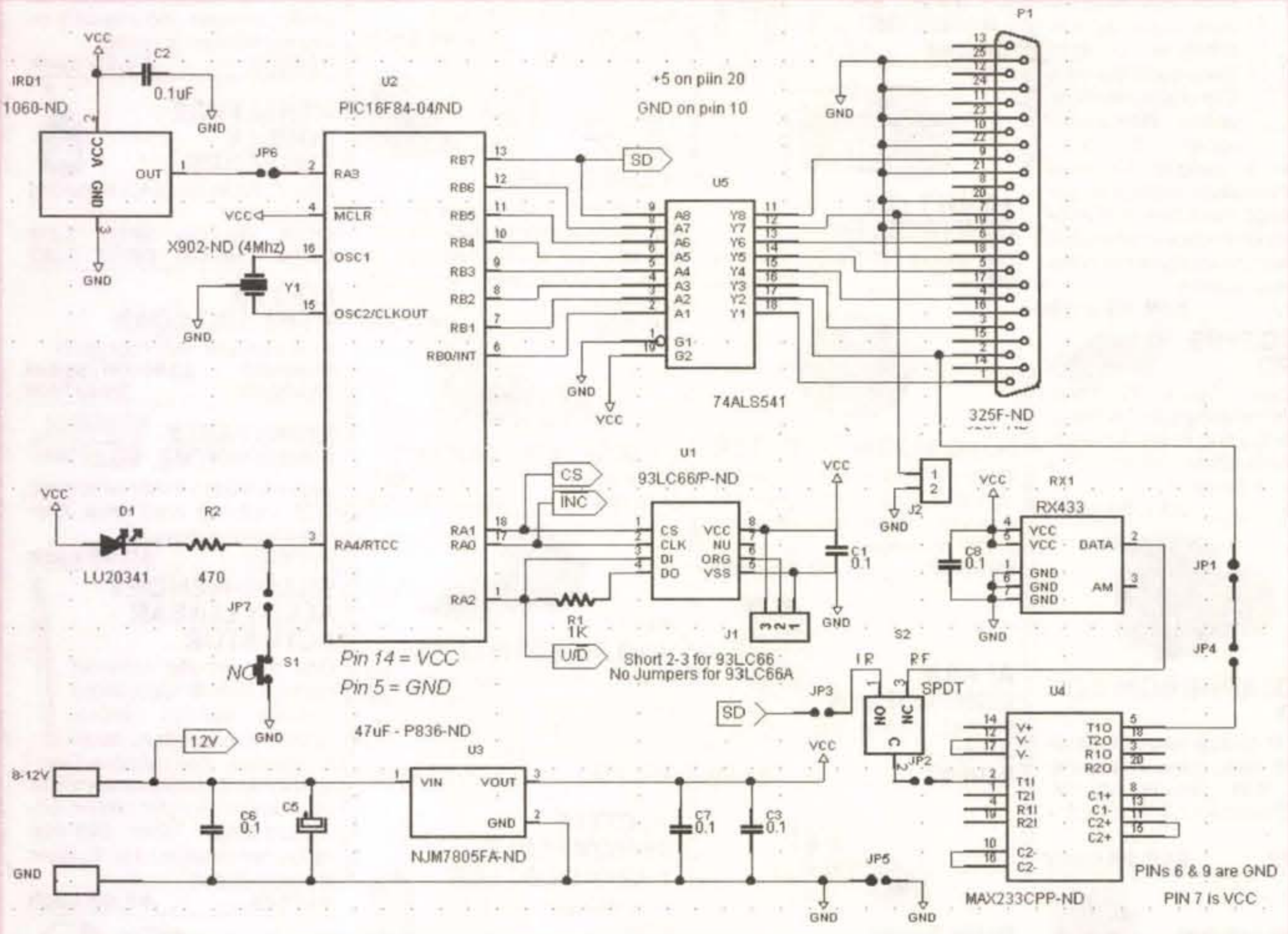
between the wipers (W0 and W1) and the ends of the potentiometers by 1 dB. Additional information on the DS1802 can be found at: **www.dalsemi.com/Doc Control/PDFs/1802.pdf**

Now, if IR remote control of your volume control is what you want, check out my IR remote control add-on to the PROgramit scanner control project that was described in the Nov. '97 issue of *Nuts and Volts*.

This circuit includes a remote volume control based on a Dallas Semiconductor DS1804 digital potentiometer. A PIC microcontroller can learn the IR patterns produced by the volume up and down buttons of most any handheld remote and use these to control the volume of the applied audio signal.

For more information on this project, visit my WEB page at **www.qsl.net/ka2pyj/progamitirxt.htm**

John Montalbano
Middletown, NJ



features, or you can get a top-of-the line system for $200.00+ which includes the remote keyless entry, alarm, and remote starter.

The remote starter is a great feature to have if you live in a cold climate. These systems maybe purchased at any local electronics retailer like Circuit City or Best Buy.

Jim Teague
Coatesville, PA

ANSWER TO #12994 - DEC. 1999

I have an RCA VCR model No. VKP925T. When I try to play a cassette, the entire screen is filled with neat columns and rows of the same cipher.

The Pak-Man screen is a common problem with the RCA VKP925. The on-screen character generator IC is bad. It is located in the base unit near the fluorescent display. It is a larger IC 0.4" wide with about 30 pins.

The IC number is MB88303. It's available from any RCA parts dealer. The cost of that IC should be about $20.00.

Reed Adams
via Internet

ANS. #1 TO #12997 - DEC. 1999

I am investigating using a PC to operate different peripherials. What prevents Turbo C from being used to implement many programs is its dependence on the system clock, 18.2 ticks per second, much too slow for many applications.

However, a book describing Microsoft C v6.0, says it is able to measure events much quicker, 450,000 ticks per second.

Does the speed of response for a C program depend on the particular compiler being Visual C, Ansi C, etc.?

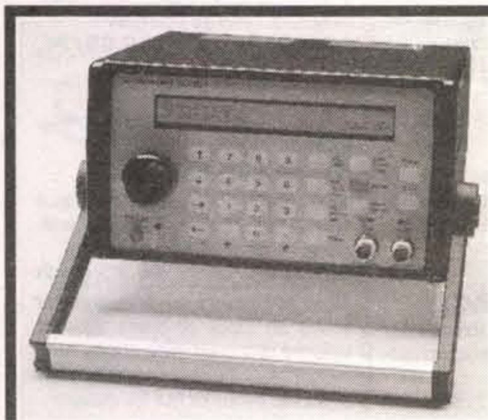
Turbo C is quite independent on the 18.2 Hz system clock provided by your PC. Turbo C is merely a programming language. Like most C language compilers, Turbo C comes with a "standard" library of already-written and compiled subroutines.

The dependence you refer to is a property of the library function named "clock;" it is not a property of the compiler, or the Turbo dialect of the C language.

Turbo C itself is capable of harnessing anything that your hardware is capable of providing. You are under no constraint whatsoever to use only functions provided by Borland.

On a PC running in real physical address mode, a program written in Turbo C can access any of the hard-

Continued on page 64

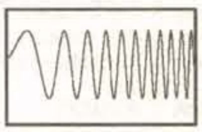


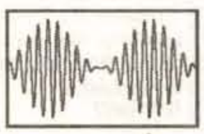
Telulex Inc. model SG-100A

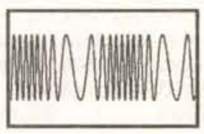
New Features: ✔ 21.5 MHz ✔ .01 Hz steps ✔ multi-unit phaselock

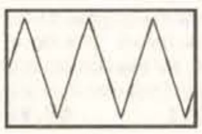
Any waveform you want!

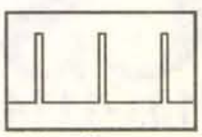
- **Synthesized Signal Generator** Clean sinewaves DC-21.5 MHz with .001% accuracy! .01 Hz steps. DC Offset. RS232 remote control.
- **Arbitrary Waveform Generator** 40 Megasamples/Second. 32,768 points. 12 bit DAC
- **Function Generator** Ramps, Triangles, Exponentials, Noise & more. 0 to 2 MHz in 1 Hz steps. Continuous or Triggered.
- **Pulse Generator** Digital waveforms with adjustable duty cycle


DC to 21.5 MHz linear and log sweeps

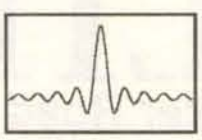

Int/Ext AM, SSB, Dualtone Gen.

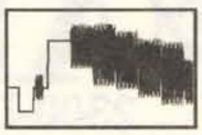

Int/Ext FM, PM, BPSK, Burst


Ramps, Triangles, Exponentials


Pulse Generator


Noise


Arbitrary Waveforms


Unlimited Possibilities!

Telulex Inc.

2455 Old Middlefield Way S
Mountain View, CA 94043
Tel (650) 938-0240
Fax (650) 938-0241
http://www.Telulex.com
Email: sales@Telulex.com

Write in 91 on Reader Service Card.

Download our latest catalog at http://www.alltronics.com Download our latest catalog at http://www.alltronics.com Download our latest catalog at http://www.alltronics.com

SOLAR FURNACE!
Build your very own solar furnace with this giant (approx. 30" x 40") Fresnel lens. The men in the photo are our staff scientists melting metal with the furnace they made. It's capable of generating over 2500°F.
99L003 $99.95 each

SPRING RETURN ROCKER SWITCH
SPDT, center off. Rated 125VAC @ 12A, 250VAC @ 6A. Marked "UP" and "DOWN." 95¢ each
99B002 95¢ - $7.50/10

ULTRABRIGHT WHITE LED
T1¾ ultrabright white, 5.6cd. This will stun your eyes!
SE5084J $4.95 each

12V EMERGENCY LIGHT MODULE
This is an ultra-bright light that uses very little energy and lasts and lasts. Good for emergency use to light a room or deck. 12VDC @ 180mA drives all 18 *white* LEDs!
DIY-18 $89.95 each

Fluke Type
METER PROBE KIT
Shrouded type banana plugs fit Fluke and other popular DMMs.
97Z017 $4.95 set

GENERAL INSTRUMENTS UNIVERSAL REMOTE CONTROL
Model XRC110. 44-button transmitter controls up to four units, i.e., TV, VCR, Cable Box, Digital Audio Tuner. Easily programmed as your needs change. Indicator lights show which device is being controlled. Volume control may be programmed to work even though the rest of the transmitter is in a different mode. Works with equipment from many manufacturers. Will do a "code search" for the correct code. Batteries and detailed instructions.
98V011 $9.95 each

IR TOGGLE SWITCH
A very useful kit. Everybody has infrared transmitters at home - TV remote, video remote, CD remote, etc. Use ANY Infra Red remote to toggle this switch on or off. Relay output rated at 12VDC/10A or 240VAC/5A.
KIT 58 $19.95

CHANGE YOUR VOICE!
With this easy-to-build vocal special effects kit. You get all these great features: Clip-on electret microphone; Removable speaker; Sound effects selector; Long Battery Life (4 AA's not included); Adjustable volume control; robot, bear and chipmunk sound effects; Up/down pitch shifts; Special vibrato mode; Step-by-step instructions.
95K002 $49.95 each

PROTOTYPE BOARD
1 Distribution Strips - Tie Points 100. 2 Terminal StripS - Tie Points 1280. 2 Binding Posts. Mounted on a Name Plate. 100mm W x 215mm L x 31mm H
PB105 $11.69 each

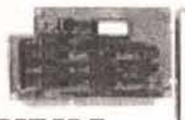
24V DIAPHRAGM AIR PUMP
24VDC @ 400mA (max.). Free air 0.3 CFM. Max. pressure approx. 11 lbs. Max. vacuum approx. 28"Hg. Dimensions 4"W x 4½"L x 3½"L.
99U002 $19.95 each

PIEZO HORN TWEETER
3.375" sq. x 2.75" deep. Mounts in 3" hole, 0.438: deep. Mounting holes: 2.75" spacing. Freq. response: 2KHz-20KHz. Sensitivity: 92dB (1W/1M) Max. power: RMS - 75W. Impedance: 4-8 Ohms.
99V015 $4.95 each

14-DAY PROGRAMMABLE TIMER
Originally used to control a satellite receiver through its IR port. Time on/off for eight distinct events. Modify it for your needs or dismantle it for its parts. Programmable with a 2732 EPROM in a removable "personality" module, the unit may be modified to control any IR device through its IR port. Contains Z80 CPU, clock display and associated parts. Operates from 9VDC 500 mA wall transformer which is included.
92V014 $9.95 each

RS-232 BREAKOUT BOX
Use to test and repair RS-232 devices, and open signal lines. One each male and female RS-232 connector. 10 LEDs. 24 switches. Needs no power or batteries - powered by buss data. 20 jumper wires included.
97Z005 $24.95 each

14.5VAC 1A TRANSFORMER
95N002 $3.95



16-BIT IDE CONTROLLER
For hard drives 500MB or less only.
96C012 $2.99 each

MINI HORN TWEETER
2" dia., 4 Ohm tweeter is ideal for car stereo applications. Seven-inch wire lead. Two mounting holes are 2.375" on center.
99V003 $1.95 each

ALARM CONTROLLER
RFD transmitter used on auto alarms.
97U007 $3.95

Guts From SOUND ACTIVATED ALARM CONTROLLER
Noise-discriminator type, removed from "SoundScan" intrusion alarms. Lots of good parts!
98Z006 $4.95 each

HPIB/GPIB CABLES
Your choice $19.95.
HPIB-1 (1 Meter)
HPIB-2 (2 Meter)
HPIB-4 (4 Meter)
HPIB-6 (6 Meter)

6 METER FSK RECEIVER
Crystal controlled on 50.675 receive frequency. Superhet with 10.7MHz IF. Three ICs and one transistor. Not a kit! New, with schematics and spec sheet for major components.
92A067 $9.95 each

MERCURY RELAY
Contacts: N.O., 35A, 480VAC. Coil: 240VAC. SPST. Magnacraft P/N WM35A-240A.
97B021 $14.95 each

SIX-WIRE UNIPOLAR STEPPER MOTOR
7.5°/step, 48 s/rev, 36 Ohms. With brass gear 2-3/16" dia. x 1" thick. Nippon Pulse # PF55-48C5.
97M009 $2.49 each

HEAVY-DUTY TARP CLAMP
To use this 3" clamp, slip a rope into the hole, slide bar forward, and the jaws will ratchet fast against tarp or awning. Many other possible uses.
99Z008 $1.99 each

9V BATTERY HOLDER
PC mount. 95¢ each
99E011 10 for $7.50

RED PROJECTION LENS
Used in rear-screen projection TV sets. Also useful for photography and laser light shows. Focal length = 7.5mm; diameter = 75mm.
99L001 $24.95 each

LOCTITE REMOVEABLE THREADLOCKER
Type 242. 0.34-oz. (10ml) bottle.
99Z001 $2.49

UNIPOLAR STEPPER MOTOR DRIVER IC
UCN5804. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 timer, parallel port, etc. Build your own robot, anything that requires precision positioning.
93I002 $4.50 each

PULSE MOTOR
42mm dia., 22mm thick. Shaft: 3mm dia. x 12mm long, with 13-tooth gear approx 16.6mm dia x 5mm thick. 7.5°/step, 48s/rev., 12VDC, 50 Ohms, 6-wire. With spec sheet.
92M010 $3.95 each

SPECIAL PACKAGE!
One 93I002 IC and 92M010 motor (both shown above) with schematics.
93I003 $7.95/set

BOOM MIKE

Electret condenser type. This versatile microphone may be wired for handy-talkie, sound card, telephone, base station, aircraft radio, CB radio, motorcycle intercom, etc. An earphone or miniature speaker may be installed in either or both muffs. The microphone unit can be easily removed and installed on another headset or helmet.
92A001 $4.95 each

MINIATURE TOGGLE SWITCHES
25VAC, 3A @ 250 VAC. Mounting hole: 0.25".
CT21 On/On SPDT 1.09
CT24 On/On DPDT 1.39

RG-178 MINI 50Ω COAX
2mm diameter. 250-Foot spool.
95W009 $100.00/spool
95W010 59¢/foot

REMOVABLE HARD DRIVE
Syquest SO555 44MB removable SCSI cartridge hard drive. (Removed during upgrade)
97C024 $9.95 each

SHAPE-MEMORY ALLOY LINEAR ACTUATOR
One inch-pound actuator made of Tinel.® Applications include robotics, doors, valves, toys, shutters, security devices, manipulators. Operated by temperature or electricity. De-energized length: 100mm. Energized length: 75mm. Self-activating temperature: 165°F. Spec sheets included.
95T001 $7.95 each

250 WATT TRANSISTOR PAIR
Complementary pair MJ15024 (NPN) and MJ15025 (PNP), used for high power audio and other linear applications. Over 100W RMS power output. 250 P_D Watts @ 25°C. 250 V_{CEO}. 15/60 h_{FE} @ Min/Max. 8 I_C Amps. 8 f_T MHz typical. 80 V @ 2.2A ISB. Application notes included. Sold as pair only.
96S001 $9.95/Pr.

DESKTOP AC TRANSFORMER
Input: 120V, 60Hz, 20W. Output 18VCT @ 750mA. For use with audio radio or video equipment.
99E010 $4.95 each

Note: We have a large quantity of these on stock at press time. A volume discount may apply, typically for lots in excess of 100 pieces or more. Email or fax for details!

ALLTRONICS

2300-D Zanker Road - San Jose, CA 95131-1114
World Wide Web: http://www.alltronics.com
(408) 943-9773 - Fax (408) 943-9776

Store Hours: 9-6 M-F & 10-3 Sat. - Pacific
Visa, M/C, AmEx Accepted. All Sales Final.
California Residents Add Sales Tax.
Shipping Additional on All Orders
Prices Subject to Change Without Notice.
Prices Good 60 Days from Date of Publication

Visit our website and download our catalog. 0001

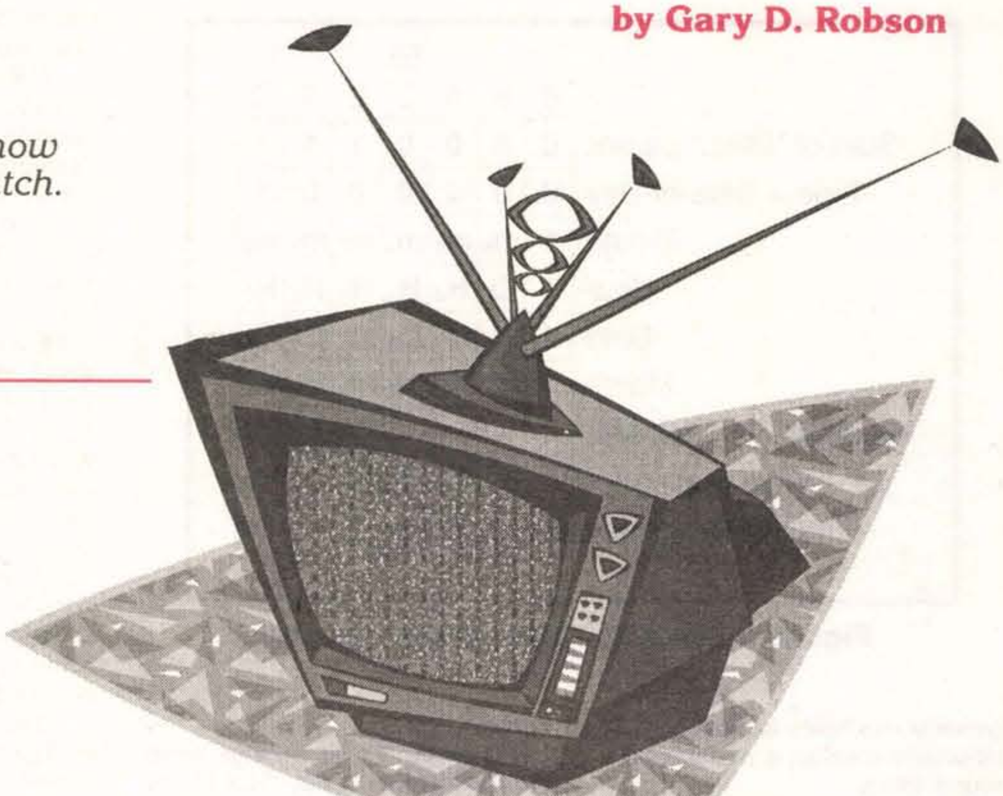
Download our latest catalog at http://www.alltronics.com Download our latest catalog at http://www.alltronics.com Download our latest catalog at http://www.alltronics.com

Write in 61 on Reader Service Card.

What can you do with the data?

- *Make transcripts of your favorite shows.*
- *Set up your own "TV Agent" to let you know when there's something interesting to watch.*
- *Track Internet links.*
- *Set the time on your computer.*
- *Watch for weather alerts in XDS.*
- *Collect song lyrics.*

by Gary D. Robson



Closed Captions, V-Chip, and Other VBI Data

There's more in your TV signal than just video and audio. Closed captions, V-chip information, time of day, program and network information, Internet links, and more lurk within the broadcast signal just waiting for you to pull it all out.

Remember those old TV sets with the "vertical hold" knob? If you turned the knob a bit, you'd see parts of two frames, with a black bar between them. That black bar is the VBI, or vertical blanking interval. It actually consists of the first 21 scan lines of the picture, although what's contained there is non-picture data and synch signals.

In 1976, the Federal Communications Commission (FCC) reserved line 21 of the VBI for closed captioning. Since mid-1993, all television sets 13" and larger have been required to have caption decoders built in. If your TV is newer than that, you can press the "CC" button on your remote or choose "captioning" from your on-screen menu, and watch the program audio rendered as text on the screen.

•

With the recent proliferation of inexpensive TV tuner cards for computers, you now have an easy way to get this data into your computer and manipulate it.

What's actually in there

Each picture line in a television signal has two fields. Each field of line 21 contains a single stream of data, containing different types of data packets. The bandwidth was kept very low to make the data as robust as possible, so each field of each frame can contain only two seven-bit characters. Since video is transmitted at 30 frames per second, that gives us 60 characters per second in each field.

Field 1 of line 21 contains two captioning channels (CC1 and CC2) and two "text" channels (TEXT1 and TEXT2). All four of these data channels share that 600 CPS data stream, and the information is sorted out using packet headers. Field 2 contains a matching set of data channels (CC3, CC4, TEXT3, and TEXT4), and can also contain extended data services (XDS) packets.

If you consider a "word" to be five characters plus a space, then we theoretically have 600 words per minute of bandwidth in field 1. Theoretically, this should be plenty for two caption channels, but when overhead, positioning information, attribute data, and the two text channels are factored in, it may not be enough. On top of all that, dialog comes in bursts, and it's those bursts that would likely be synchronized to happen on both caption channels at once.

For this reason, programs with two caption channels will typically put the second caption stream into CC3, which gives each caption stream its own 600 CPS of bandwidth. An example is CBS' "60 Minutes," which puts English captions in CC1 and Spanish captions in CC3.

The character set used for this data is a slightly modified seven-bit ASCII. All of the standard alphanumeric characters are where you would expect them, but some accented letters have been relocated into the hex 20-7F range. The full character set can be found in my Closed Caption FAQ at www.robson.org\capfaq\caption charset.html.

Closed caption and text data

The vast majority of programming in the US uses only CC1 for caption data. Until recently, few programs actually had captions, but the Telecommunications Act of 1996 made captioning mandatory. As of January 2000, the first milestone in the Telecom Act requires a minimum of five hours per day on each channel, and some channels caption much more than that, so there's plenty of caption data out there.

Although the caption data specification (EIA-608) allows for italicizing, underlining, flashing (blinking), and various foreground colors, the only attribute used with any regularity is italics. Captioners

What's A V-Chip?

Don't try tearing apart your television set looking for the V-chip. You won't find it. Even though all televisions must contain a "V-chip" now by law, there really is no such thing.

The data for the V-chip, as the article explains, is simply XDS packets containing parental content advisories. Since the TV must contain circuitry to interpret captioning information in the VBI, the V-chip capabilities were added to the captioning chip.

The V-chip, short for "violence chip," allows parents to control what shows their children can watch. To use this capability, you set filters on your TV. Depending on the rating system being used, you can get fairly detailed.

For example, you might choose to allow anything rated TV-14, unless it contains excessive violence (TV-14-V). The set will then monitor the incoming signal, and if it detects anything rated TV-14-V or higher, the audio, video, and captions will be blocked.

The visible content advisory icon that appears in the corner of your screen at the beginning of a program is not generated by your television, and isn't dependent on the V-chip data. The V-chip data is also retransmitted constantly so that if you change channels, it will detect the new rating quickly.

	bit 6	5	4	3	2	1	0
Start of "Misc." packet	0	0	0	0	1	1	1
Type = Time-of-Day	0	0	0	0	0	0	1
Minute	1	m_5	m_4	m_3	m_2	m_1	m_0
Hour	1	D	H_4	H_3	H_2	H_1	H_0
Date	1	L	D_4	D_3	D_2	D_1	D_0
Month	1	Z	-	M_3	M_2	M_1	M_0
Weekday (1 = Sunday)	1	-	-	-	W_2	W_1	W_0
Year (add 1990)	1	Y_5	Y_4	Y_3	Y_2	Y_1	Y_0
End of XDS packet	0	0	0	1	1	1	1

Figure 1. The XDS "Time of Day" Packet

typically use italics to designate an off-screen speaker, a narrator, or a sound effect.

If you're going to save captions to a text file, then you'll probably want to do your own wordwrapping. Most closed captioning starts a new line at the end of every sentence, and the 32-character line width is shorter than you'd want for most applications. The typical flag for "change of speaker" is a pair of greater-than symbols at the beginning of a line, which may or may not be followed by a speaker identification.

In most cases, the only service in field 1 with data in it will be CC1. If you aren't using a card that sorts out the data services for you, there's an easy way to deal with the raw byte stream in that CC1-only situation. Just take any block of consecutive bytes less than 20h, and replace them with a single space. You can use a simple lookup table to do the substitutions where the character set deviates from US-ASCII.

Caution: If you try this when there's data in CC2, TEXT1, or TEXT2, it will be interspersed in your CC1 data, and will make everything totally unreadable. Your best bet is to look for a TV tuner card that separates the data services for you.

Closed caption data may be positioned anywhere on the screen, and there can't be more than four lines (rows) visible at a time. Captions are typically positioned so that nothing critical in the picture will be covered. Text data, on the other hand, is designed to fill the screen (although some televisions limit it to half), completely covering the picture.

Interactive TV and Internet data

Traditionally, the text channels have been used for things like on-screen program guides, but they are rarely used today. The most common use of text is for ITV (Interactive Television) Links.

ITV Links were developed by WebTV and VITAC as a way to transmit Internet URLs (Uniform Resource Locators) in the video signal for set-top boxes. These URLs point to web pages that contain more information about the program or commercial currently airing.

For example, during a program about electronics magazines, the station may insert an ITV link pointing to *Nuts and Volts* magazine. When that link is broadcast, people with WebTV Plus set-top boxes would see an Internet icon in the corner of their TV screen. They could then press a key on their WebTV controller, and be taken directly to the *Nuts and Volts* home page, or whatever page was indicated.

The ITV link itself is broadcast in TEXT2, using US-ASCII (ISO-8859-1) characters rather than the modified closed caption character set described above. It consists of a URL enclosed in angle brackets, an optional series of attributes in square brackets, and a checksum.

The only attributes you're likely to care about if you're parsing ITV links are the URL and the name of the link. To find the name, scan for the text "[name:" (or just "[n:"), and parse to the next closing square bracket.

The URL field is not limited to only web addresses, so if you're using these links, be prepared to deal not only with http links, but with mailto, news, and other link types as well. For example, an ITV link might look like this:

<mailto:gary@robson.org>
[t:s][name:Email the Author]
[expires:20000521T115959]
[CE8A]

Where To Get More Information

If you want to get serious about decoding and interpreting captioning and other line 21 data, you'll want to pick up the appropriate standards documents. You can get them from:

Global Engineering Documents
15 Inverness Way East
Englewood, CO 80112-5776
Phone: 1-800-854-7179
(US and Canada)
303-397-7956 (International)
E-Mail: global@ihs.com
Web: global.ihs.com

Be prepared to pay, though. The base document — EIA-608 — is over $100.00, and there are auxiliary documents you would also need.

The author of this article has written a book called *Inside Captioning*. It does not have detailed instructions for decoding line 21 data, but it does have extensive information about the industry, the technology, and the history of captions. It is available from CyberDawg Publishing at www.cyberdawg.com/captioning/.

If you want to do your research on the Web, you can start with the Closed Caption FAQ (frequently asked questions) at www.robson.org/capfaq/.

The [t:s] is a "type" field, the expiration date tells you how long the link will be good (May 25, 2000 at 11:59:59 in this example), and the final [CE8A] is a checksum (see Internet RFC 1071 for details).

XDS data

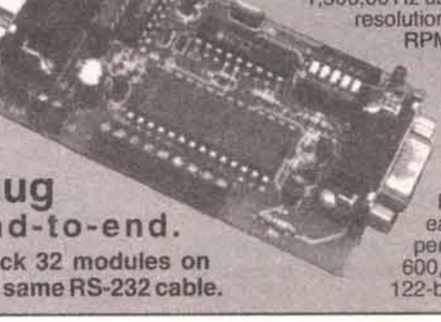
The extended data services

Weeder Technologies
VISA MasterCard
RS-232 Stackable
www.weedtech.com Data Book Available 850-863-5723

Digital I/O Module - 14 I/O pins individually configured for input or output. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. One-shot pulse output with user programmable length. **$49**

Analog Input Module - 8 input pins. 12-bit plus sign self-calibrating ADC reads voltages from 0 to 4095 mV using 1 mV resolution. Supports single-ended, differential, or pseudo-differential modes. Software programmable alarm trip-points for each input. **$59**

Stepper Motor Driver - Drives a unipolar stepper motor rated up to 25VDC @ 2A. Uses automatic self-generated parabolic acceleration/deceleration curves for smooth start and stop motion. Software programmable ramp-rate and speed. 24-bit absolute motor position counter. Limit-switch input. **$59**



Pulse Counter/Timer - Read frequency from 0.50000 to 1,500,00 Hz using floating decimal point and 5-digit resolution throughout range. Measure period, RPM, duty cycle, pulse length, velocity of a projectile using a pair of trip wires. Accumulate pulse count. **$69**

Multi-Drop Peripheral Interface
Plug a third-party RS-232 peripheral into the multi-drop bus. Appended header character allows PC to exclusively communicate with each of up to 32 devices. Supports peripheral baud rates of 75, 150, 300, 600, 1200, 1800, 2400 and 9600. Built-in 122-byte FIFO RAM buffer. **$59**

Plug end-to-end.
Stack 32 modules on the same RS-232 cable.

Electro Mavin
Great Buys - Great Products - Great Gadgets
Check Out Our Great WebSite at
http://mavin.com
For Computer Items, Hobbiest Projects, Microwave Goodies and Some of the Greatest Prices on the Web....
800-421-2442 or FAX 310-632-3557
E-Mail
john@mavin.com or mark@mavin.com

Your Own TV-Watching Agent

Once your computer can read line 21 data from the VBI, an obvious application would be a program to "watch" a specified channel and notify you when something of interest comes up.

Such a program would require a triggering mechanism, such as recognition of a word or phrase from a keyword list. Make sure your keyword checking is not case-sensitive, as most, but not all, captioning is done in uppercase. You could also trigger on ITV links or XDS data.

Once you've defined your triggers, you need to define the action. Do you want the program to notify you, using audible alerts? Do you want it to activate a full-screen TV picture on your computer, with the volume turned up? Do you want it to save you a transcript for later? Turn on a VCR? Send you an E-Mail? Page you?

If you're going to have the program save caption data, make sure you back up a bit from the place where the keyword was recognized, so that you get the whole story in context.

You'll also need a trigger to turn it off. The easiest way to do this is with a timer. If you do that, you should reset the timer every time a keyword is triggered, so that you'll get all of a long story. You might also want to be more liberal with your keywords in this second trigger.

For example, if you're scanning CNN for mention of Apple Computer, you wouldn't want to use the keyword "apple" as a trigger, or you'd get far too many false hits. Once you've triggered on Apple Computer, though, you would probably want any mention of the word "apple" to keep the recorder running.

provide information about the current program, TV station, and network. Unlike the caption and text data, they are packets rather than continuous streams of data.

The XDS packet most likely to change the world is the time-of-day packet. VCRs and TVs can use it to set their own clocks, eliminating the "blinking 12:00" phenomenon so common in non-techie households. Other XDS packets include:

- Name, length, and start time of current show
- Type of show, based on a set of category codes
- Program content advisory (see "V-chip data" below)
- Network name
- Station name and number
- National weather service warning codes

To read XDS information, scan the data stream from line 21 field 2. The start code for an XDS packet is a byte less than 0Fh followed by a packet type byte. The end code is a 0Fh byte. As an example, if you wished to set your computer's clock from the TV signal, you'd scan for a packet starting with 07h 01h, as in Figure 1.

There are a few oddities about this packet that need to be explored. First, the seconds. Rather than transmitting a whole byte for the seconds, the Z bit is set to 1 whenever the seconds are zero. This means that setting the time could take as long as a minute, while you wait for the seconds to tick over. You could also just watch for the minute value to change, and use that as your "seconds = 0" indicator. The Z bit allows this process to be stateless.

All times are UTC (also known as GMT, or Greenwich Meridian Time). You need to know the time zone you're in to set your local clock. If the D bit is on, it is daylight savings time.

To set the date, add 1990 to the value of the year bits. Yes, this means the system will break down in 2054, but the broadcast industry expects everyone to be switched over to DTV by then, where this mechanism is different.

If the date shows as March 1, but your time zone indicates that your clock should be set a day earlier, you can use the L flag to determine if it is a leap year. If the L flag is on (one), then the date is February 29. Otherwise, it is February 28.

If you wish to decode and interpret these packets further, you'll want a copy of the EIA-608 specification (see the sidebar, "Where To Get More Information").

V-chip data

XDS is also how the infamous V-chip gets its data (see the sidebar, "What's A V-Chip?"). The V-chip spec supports four different rating systems, although any one program can only be rated using one system.

MPAA is the rating system you're used to from the movies (G, PG, PG13, R, NC17, and X).

US TV Parental Guidelines is the new system developed specifically for V-chip (TV-Y, TV-Y7, TV-G, TV-PG, TV-14, and TV-MA).

Canadian English is used throughout all of English-speaking Canada. Canadian French is used in Quebec.

Let's look at the anatomy of a typical V-chip packet. It will always begin with the two-byte pair 01h, 05h. The meaning of the next two bytes varies depending on the rating system.

Since the US TV Parental Guidelines is the system you'll see the most, we'll use that one. The next two bytes would look like Figure 2.

The D, V, S, and L bits are flags that further refine the rating. The D flag indicates sexually suggestive dialog, V is violence, S is sexual situations, and L is strong language.

Like all other XDS packets, the parental guidelines packets must end in 0F hex. To put this all together, a program rated TV-PG-V would have a V-chip packet of 01h 05h 48h 64h 0Fh.

bit	6	5	4	3	2	1	0
Byte 1	1	D	0	1	0	0	0
Byte 2	1	V	S	L	G_2	G_1	G_0

G_2	G_1	G_0	Rating
0	0	0	none
0	0	1	TV-Y
0	1	0	TV-Y7
0	1	1	TV-G
1	0	0	TV-PG
1	0	1	TV-14
1	1	0	TV-MA
1	1	1	none

Figure 2. A V-Chip Data Packet

What now?

Once you have figured out how to read and interpret this data, what do you do with it? You could:

- Make transcripts of your favorite shows. Note that this information is a copyrighted part of the video, and you can't sell it or post it on your web site.
- Make a smart "TV Agent" that runs in the background and tells you when there's something interesting to watch (see the sidebar, "Your Own TV-Watching Agent").
- Track Internet links. When an ITV link appears, automatically feed it to your web browser so you can see what's related to your current show.
- Set the time on your computer.
- Watch for weather alerts in XDS. You could tie this to audible alerts, or even have your computer use the modem to call your pager or cell phone. Don't rely on getting your alerts here, though, because few stations actually broadcast them.
- Collect song lyrics. Not that many music videos are captioned today, but the number is increasing steadily as the Telecommunications Act mandate begins to take effect. Again, be careful of copyright considerations here.

I even found someone who had built a "commercial killer" by detecting patterns in line 21 data that usually indicate the start and end of commercials. His would mute the volume on the TV when it detected a commercial, but yours could do whatever you wish.

Good luck, and have fun mining line 21. If you come up with an interesting application for caption data on your computer, E-Mail me and let me know! **NV**

About the Author

Gary Robson has been developing captioning technology for over 10 years, and he currently works as the Chief Technology Strategist for VITAC Corporation, the largest closed captioning company in the US. Many more of Gary's articles and columns about closed captioning can be found on his web site at www.robson.org/gary/, and you can contact him via E-Mail at gary@robson.org.

Mr. NiCd
JANUARY 2000 SUPER SPECIALS!
THE BEST BATTERIES IN AMERICA!

Packs & Charger for YAESU FT-50R / 40R / 10R:
FNB-40xh Slim-NiMH 7.2v 650mAh $41.95
FNB-47xh (NiMH) 7.2v 1800mAh $49.95
FNB-41xh (5w NiMH) 9.6v 1000mAh $49.95
For YAESU FT-51R / 41R / 11R:
FNB-38 pack (5W) 9.6v 700mAh $39.95
For YAESU FT-530 / 416 / 816 / 76 / 26:
FNB-26 pack (NiMH) 7.2v 1500mAh $32.95
FNB-27s (5w NiMH) 12.0v 1000mAh $45.95
For YAESU FT-411 / 470 / 73 / 33 / 23:
FNB-11 pack (5w) 12.0v 600mAh $24.95
FBA-10 6-Cell AA case $14.95
Packs for ALINCO DJ-580 / 582 / 180 radios:
EBP-20ns pack 7.2v 1500mAh $29.95
EBP-22nh pk.(5w) 12.0v 1000mAh $36.95
EDH-11 6-Cell AA case $14.95
For ICOM IC-Z1A / T22-42A / W31- 32A / T7A:
BP-180xh pk. (NiMH) 7.2v 1000mAh $39.95
BP-173 pack (5w) 9.6v 700mAh $49.95
For ICOM IC-W21A / 2GXAT / V21AT: (Black or Gray)
BP-132s (5w NiMH) 12.0v 1500mAh $49.95
For ICOM IC-2SAT / W2A / 3SAT / 4SAT etc:
BP-83 pack 7.2v 600mAh $23.95
For ICOM 02AT etc & Radio Shack HTX-202 / 404:
BP-8h pack 8.4v 1400mAh $32.95
BP-202s pack (HTX-202) 7.2v 1400mAh $29.95
For KENWOOD TH-79A / 42A / 22A:
PB-32xh pack (NiMH) 6.0v 1000mAh $29.95
PB-34xh pack (5w NiMH) 9.6v 1000mAh $39.95
For KENWOOD TH-78 / 48 / 28 / 27:
PB-13 (original size!) 7.2v 700mAh $26.95
For KENWOOD TH-77, 75, 55, 46, 45, 26, 25:
PB-6x (NiMH, w/chg plug!) 7.2v 1200mAh $34.95

Mail, phone, & Fax orders welcome! Pay with Mastercard / VISA / DISCOVER / American Express
Call 608-831-3443 / Fax 608-831-1082
Mr. NiCd - *E. H. Yost & Company*
2211-D Parview Road, Middleton, WI 53562
CALL OR WRITE FOR OUR FREE CATALOG!
Cellular / Laptop / Videocam / Commercial & Aviation packs too!
E-mail: ehyost@midplains.net

WESTERN TEST SYSTEMS

WE BUY AND SELL

Inquiries **307-635-2269** • Fax **307-635-2291**

Orders **800-538-1493**

2701 Westland Court, Unit B, Cheyenne, Wyoming 82001

OSCILLOSCOPES & ACCESSORIES

OSCILLOSCOPES

TEK 2445 150 MHz 4-channel Oscilloscope $1,400.00
TEK 2465 300 MHz 4-channel Oscilloscope $2,250.00
TEK 7104 1 GHz 2-Channel Oscilloscope, ... $3,000.00
w/7A29,7A29-04,7B10,7B15
TEK 7844 400 MHz Dual Beam Oscilloscope $900.00
with 7A24,7A26,7B80,7B85
TEK 7904 500 MHz Oscilloscope, ... $900.00
with 7A24, 7A26, 7B80, 7B85

PROBES

HP 1122A Probe Power Supply $150.00
HP 54701A 2.5 GHz 10X FET Probe, ... $1,000.00
for 54700 series oscilloscopes
TEK 1101 Accessory Power Supply, for FET probes $175.00
TEK A6901 Ground Isolation Monitor $200.00
TEK A6902B Voltage Isolator, ... $600.00
DC-20 MHz, 20 mV-500 V/div.
TEK P6046 100 MHz Differential Probe $500.00
TEK P6201 900 MHz 1X/10X/100X FET Probe $450.00
TEK P6202A 500 MHz 10X FET Probe $250.00
TEK P6204 1 GHz 10X FET Probe, for TDS series $450.00
TEK P6205 750 MHz 10X FET Probe, for TDS series $325.00
TEK P6701-opt.02 O/E Converter, ... $175.00
450-1050 nm/0-1 mW: DC-700 MHz, ST conn.

CALIBRATION

TEK 067-0587-02 Signal Standardizer Calibration Fixture $750.00
TEK SG503 Level Generator, ... $600.00
250 kHz-250 MHz, TM500 series

WAVEFORM GENERATORS

FUNCTION

HP 3312A 13 MHz Function Generator $500.00
HP 3325A 21 MHz Synthesized Function Generator, HPIB $1,000.00
HP 3325A-002 21 MHz Synthesized $1,500.00
Function Generator, HV output option
HP 8165A-002 Prog. Signal Source, ... $1,250.00
1 mHz-50 MHz, log sweep
TEK AWG5102 Arb.Waveform Gen., ... $900.00
20 MS/s,12 bits,50ppm synthesis <1MHz
TEK AWG5105-opt.02 Arbitrary $1,250.00
Waveform Generator, dual channel option
TEK DD501 Digital Delay & Burst Gen., ... $275.00
for function & pulse gen's
TEK FG501 1 MHz Function Generator, TM500 series $225.00
TEK FG502 11 MHz Function Generator, TM500 series $300.00
TEK FG503 3 MHz Function Generator, TM500 series $250.00
TEK RG501 Ramp Generator, TM500 series $175.00
WAVETEK 288 20 MHz Synthesized $750.00
Function Generator, GPIB

PULSE

BERKELEY NUCLEONICS 7085B $650.00
Digital Delay Generator, 0-100 mS, 1 nS res.,5 Hz-5 MHz
HP 8007B 100 MHz Pulse Generator $600.00
HP 8012B 50 MHz Pulse Generator, variable transition time $600.00
HP 8080A/81A/83A/84A 300 MHz Word Generator $800.00
HP 8080A/91A/92A/93A r $950.00
1 GHz Single Channel Pulse Generato
HP 8082A 250 MHz Pulse Generator $1,250.00
HP 8111A 20 MHz Pulse/Function Generator $1,100.00
HP 8112A 50 MHz Programmable $4,000.00
Pulse Generator, HPIB
HP 8115A 50 MHz Dual Channel Pulse Generator, HPIB $2,500.00
HP 8116A 50 MHz Pulse / Function Generator, HPIB $3,500.00
TEK PG502 250 MHz Pulse Generator, ... $600.00
Tr<1nS, TM500 series
TEK PG505 100 kHz Pulse Generator, ... $275.00
80 V peak, TM500 series
TEK PG508 50 MHz Pulse Generator, TM500 series $400.00
WAVETEK 802 50 MHz Pulse Generator $300.00

VOLTAGE & CURRENT

VOLTMETERS

FLUKE 845AR High Impedance Voltmeter / Null Detector $400.00
HP 3456A 6-1/2 Digit Voltmeter, HPIB $500.00
HP 3457A 7-1/2 digit Voltmeter, HPIB $1,200.00
HP 3478A 5-1/2 digit Multimeter, HPIB $600.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter, ... $900.00
10 nV sensitivity, GPIB
SOLARTRON 7081 8-1/2 digit Voltmeter $3,000.00
TEK DM5010 4-1/2 digit Multimeter, TM5000 series plug-in $300.00
TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in $225.00

CALIBRATION

FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA $450.00
FLUKE 515A Portable Calibrator, ... $900.00
DC/AC/Ohms, line & battery power
FLUKE 5220A Transconductance $3,000.00
Amplifier, DC-5 kHz, 0-20 A

VOLTAGE SOURCES

HP 6114A Precision Dual Range $750.00
Power Supply, 20 V 2 A/ 40 V 1 A
HP 6115A Precision Dual Range $750.00
Power Supply, 50V 0.8A / 100V 0.4A
KEITHLEY 228 Programmable Voltage/Current Source $1,900.00

CURRENT METERS & SOURCES

HP 4140B Picoammeter / $2,000.00
DC Voltage Source, without test fixture
HP 6181C DC Current Source, to 100 V, 250 mA $500.00
HP 6186C DC Current Source, to 300 V, 100 mA $750.00
KEITHLEY 225 Current Source, ... $500.00
0.1 uA-100 mA, 10-100 V compliance
KEITHLEY 227 Current Source, ... $800.00
1 uA-1 A, 0-50 V compliance
TEK CT-5 High Current Transformer $375.00
for P6021/A6302, to 1000A
TEK P6022 AC Current Probe $275.00
w/termination, 935 Hz-120 MHz, 6 A pk

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH $550.00
BOONTON 72BD 1 MHz Capacitance $650.00
Meter, 3-1/2 digit display
HP 4262A-101 3-1/2 digit LCR Meter, ... $1,500.00
120 Hz/ 1 kHz/ 10 kHz test, HPIB

STANDARDS

E.S.I. SR-1 Standard Resistor, various values $125.00
E.S.I. SR1010 Resistance Transfer $550.00
Standards, 1 Ohm-100 K/step
E.S.I. SR1050-1M Resistance $2,000.00
Transfer Standard, 1 Megohm/step
GR 1404-A 1000 pF Reference Standard Capacitor $700.00
GR 1406 Standard Air Capacitors, ... $375.00
GR900 connector, 0.1% acc.
GR 1432-U 4-Decade Resistor, ... $100.00
0-111.10 Ohms, 0.01 Ohm resolution
GR 1433-J 4-Decade Resistor, ... $150.00
0-11,110 Ohms, 1 Ohm resolution
GR 1433-K 4-Decade Resistor, n $150.00
0-1,110 Ohms, 0.1 Ohm resolutio
GR 1433-L 4-Decade Resistor, ... $150.00
0-111,100 Ohms, 10 Ohms resolution
GR 1433-N 5-Decade Resistor, ... $200.00
0-11,111 Ohms, 0.1 Ohm resolution
GR 1433-X 6-Decade Resistor, ... $250.00
to 111,111.0 Ohms, 0.1 Ohm res.
HP 4440B 4-Decade Capacitor, 40 pF-1.2 uF $750.00

HI & LO RESISTANCE

HP 4328A Milliohmmeter $1,200.00

T.D.R.

TEK 1503B-03,04 T.D.R., 0-50,000 ft., ... $3,000.00
chart recorder & battery power
TEK 1503-opt.04 Time Domain $1,400.00
Reflectometer, 0-50,000 feet,chart recorder

POWER SUPPLIES

SINGLE OUPUT

HP 6200B Dual Range Supply, ... $200.00
0-20 V 0-1.5 A/ 0-40 V 0-750 mA CVCC
HP 6207B 0-160 V 0-200 mA CV/CC Power Supply $200.00
HP 6256B 0-10 V 0-20 A CV/CC Power Supply $250.00
HP 6263B 0-20 V 0-10 A CV/CC Power Supply $400.00
HP 6266B 0-40 V 0-5 A CV/CC Power Supply $400.00
HP 6267B 0-40 V 0-10 A CV/CC Power Supply $550.00
HP 6274B 0-60 V 0-15 A CV/CC Power Supply $650.00
HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply $150.00
HP 6282A 0-10 V 0-10 A CV/CC Power Supply $200.00
HP 6289A 0-40 V 0-1.5 A CV/CC Power Supply $200.00
HP 6299A 0-100 V 0-750 mA CV/CC Power Supply $200.00
HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply $125.00
HP 6443B 0-120 V 0-2.5 A CV/CC Power Supply $450.00
HP 6574A 0-60 V 0-35 A CV/CC Power Supply $1,675.00
KEPCO ATE 36-30M $900.00
0-36 V 0-30 A CV/CC Power Supply
KEPCO ATE 36-8M $375.00
0-36 V 0-8 A CV/CC Power Supply
LAMBDA LK-352-FM $600.00
0-60 V 0-15 A CV/CC Power Supply
SORENSON DCR 150-3B $500.00
0-150 V 0-3 A CV/CC Power Supply
SORENSON DCR 600-0.75B $550.00
0-600 V 0-750 mA CV/CC Power Supply
SORENSON DCS 40-25 ..... $650.00
0-40 V 0-25 A CV/CC Power Supply
SORENSON SRL 20-12 0-20 V $400.00
0-12 A CV/CC Power Supply
SORENSON SRL 60-8 0-60 V $600.00
0-8 A CV/CC Power Supply
TEK PS501-1 Power Supply, ... $175.00
0-20 V, 2 mV res., 400 mA, TM500 series

MULTIPLE OUTPUT

HP 6205C Dual Power Supply, ... $300.00
0-40 V 300 mA & 0-20 V 600 mA, CV/CL
HP 6228B Dual 0-50 V 0-1 A CV/CC Power Supply $400.00
HP 6253A Dual 0-20 V 0-3 A CV/CC Power Supply $400.00
HP 6255A Dual 0-40 V 0-1.5 A CV/CC Power Supply $400.00
KEPCO MPS-620M Triple Output $250.00
Supply, dual 0-20V 1A tracking & 0-6V 5A
LAMBDA LPD-422-FM Dual $300.00
0-40 V 0-1 A CV/CC Power Supply
LAMBDA LPT-7202-FM Triple Output Power Supply $450.00
TEK PS5010 Programmable Triple Power Supply, TM5000 series $650.00
TEK PS503A Dual Power Supply, TM500 series $200.00

MISCELLANEOUS

ACME PS2L-500 Programmable $350.00
Load, 0-75 V / 0-75 A / 500 Watts max.
ELGAR 501C/400SD AC Power Source, ... $1,150.00
45 Hz-5 kHz, 500 VA, 0-135 VAC
HP 59501B HPIB Isolated DAC/ $175.00
Power Supply Programmer
KEPCO BOP 20-20M Bipolar $675.00
Op Amp/Power Supply, to 20 V 20 A
KEPCO BOP 36-5M Bipolar $400.00
Op Amp/Power Supply, to 36 V 5 A
KEPCO BOP 50-2M Bipolar $400.00
Op Amp/Power Supply, to 50 V 2 A
TRANSISTOR DEVICES DAL-50-15-100 ..... $200.00
Programmable Load, 0-50 V, 0-15 A, 100 Watts max.

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP 5314A-001 100 MHz/100 nS $275.00
Universal Counter; TCXO reference option
HP 5315A-001 100 MHz/100 nS $450.00
Universal Counter, TCXO reference option
HP 5315A-002,003 100 MHz/100 nS $650.00
Univ. Counter; batt. power & 1 GHz C-ch.
HP 5315A-003 100 MHz/100 nS $550.00
Univ. Counter, 1 GHz C-channel option
HP 5315B 100 MHz/ 100 nS Universal Counter $375.00
HP 5316A 100 MHz/100 nS Universal Counter, HPIB $600.00
HP 5316A-001,003 100 MHz/ 100 nS $750.00
Univ. Counter, HPIB, TCXO, 1 GHz C-ch.
HP 5316B 100 MHz/ 100 nS Universal Counter, HPIB $750.00
HP 5370A 100 MHz/ 20 pS 11 digit $750.00
Universal Time Interval Counter
HP 5370B 100 MHz/ 20 pS Universal Counter, 11 digits $1,200.00
PHILIPS PM6672/411 120 MHz/100 nS $450.00
Universal Counter, C-channel 70-1000 MHz
TEK DC5004 Programmable $250.00
100 MHz/100nS Counter/Timer, TM5000 series
TEK DC5009 Programmable 135 MHz $400.00
Univ. Counter/Timer, TM5000 series
TEK DC5010 350 MHz / 3.125 nS $950.00
Universal Counter, TM5000 series
TEK DC503A 125 MHz/100 nS $275.00
Universal Counter, TM500 series
TEK DC509 135 MHz/ 10 nS $275.00
Universal Counter, TM500 series

FREQUENCY COUNTERS

EIP 545A 18 GHz Frequency Counter $750.00
FLUKE 7220A-010,131,351 1.3 GHz $500.00
Counter; battery power, OCXO, and res. mult.
HP 5342A 18 GHz Frequency Counter $1,250.00
HP 5343A-001 26.5 GHz Frequency $3,000.00
Counter, OCXO reference
HP 5343A-001,011 26.5 GHz Frequency $3,500.00
Counter, OCXO reference, HPIB
HP 5345A/5355A/5356B $3,500.00
26.5 GHz CW/Pulse Frequency Counter
HP 5350B 20 GHz Frequency Counter, HPIB $2,900.00
HP 5351B-001 26.5 GHz Frequency $4,250.00
Counter, HPIB, OCXO reference
HP 5364A Microwave Mixer / $3,000.00
Detector, for modulation domain an.

STANDARDS

HP 105B Quartz Oscillator, ... $1,500.00
0.1/ 1.0/ 5.0 MHz, battery power
HP 5065A-003 Rubidium Freq. $2,750.00
Standard; clock & battery power options
HP 5087A-opt.032 Distribution $1,750.00
Amplifier, 12 outputs at 5 MHz

AUDIO & BASEBAND

SPECTRUM ANALYSIS

HP 3586C Selective Level Meter, ... $1,200.00
50 Hz-32.5 MHz, 50 & 75 ohms

DISTORTION ANALYZERS

HP 8903A Audio Analyzer, 20 Hz-100 kHz $1,500.00

RMS VOLTMETERS

FLUKE 8922A True RMS Voltmeter, ... $450.00
180 uV-700 V, 2 Hz-11 MHz

OSCILLATORS

HP 3336C-004,005 21 MHz Synthesizer/ $1,400.00
Level Gen., OCXO & hi accuracy att.
TEK SG502 Sine/Square Osc., ... $200.00
5 Hz-500 kHz, 70 dB step atten.,TM500

MISCELLANEOUS

HP 3575A-002 Phase-Gain Meter, ... $850.00
1 Hz-13 MHz, dual display
HP 461A Amplifier, 20 dB or $125.00
40 dB gain, 1 kHz-150 MHz
HP 467A Power Amplifier, ... $375.00
X1/X2/X5/X10, DC-1 MHz, 10 W output
KROHN-HITE 3103 High/Low $350.00
Pass Filter, 10 Hz-3 MHz, 24 dB/octave
KROHN-HITE 3200 High Pass / $275.00
Low Pass Filter, 20 Hz-2 MHz, 24 dB/octave

Write in 62 on Reader Service Card.

VISA

90 DAY WARRANTY PARTS AND LABOR • 10 DAY INSPECTION

TEST EQUIPMENT WANTED CALL OR FAX LIST • OPEN ACCOUNTS

MasterCard

KROHN-HITE 3202 Dual HP/LP/BP/BR ... $450.00
Filter, 20 Hz-2 MHz, 24 dB/octave
KROHN-HITE 3342R Dual HP/LP Filter, ... $900.00
0.001 Hz-99.9 kHz, 48 dB/octave
ROCKLAND 852 Dual Highpass/ ... $900.00
Lowpass Filter, 0.1 Hz-111 kHz
TEK AM502 Differential Amplifier, ... $475.00
0.1 Hz-1 MHz, TM500 series
WAVETEK 716 Brickwall Filter ... $1,500.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11517A/18A/19A/20A Mixer ... $500.00
Set, 12.4-40.0 GHz, for HP 8555A/8569A
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz ... $1,100.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 GHz ... $1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz ... $1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz ... $1,400.00
HP 70620B Preamplifier, 1.0-26.5 GHz, for 70000 series ... $3,900.00
HP 8559A/853A-001 Spectrum ... $3,750.00
An., 0.01-21 GHz, 1 kHz res.,w/rackmount frame
HP 85640A Tracking Generator, ... $5,000.00
300 kHz-2.9 GHz, for HP 8560 series
HP 8568B Spectrum Analyzer, ... $8,500.00
100 Hz-1.5 GHz, 10 Hz min. res.
HP 8569B Spectrum Analyzer, ... $6,500.00
10 MHz-22 GHz, 100 Hz min.res.bw.
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz ... $1,500.00

NETWORK ANALYZERS

HP 11650A Network Analyzer Accessory Kit, APC7 ... $600.00
HP 35676A Reflection/Transmission Test Kit, 5 Hz-200 MHz ... $1,000.00
HP 85020A Directional Bridge, 10-4300 MHz, N(f) test port ... $650.00
HP 85027E Directional Bridge, ... $1,900.00
0.01-26.5 GHz, APC3.5(f) test port
HP 85046A S-Parameter Test Set, 300 kHz-3 GHz ... $3,000.00
HP 85054A Type N Calibration Kit, for HP 8510 series ... $1,800.00
HP 8757C-001 Scalar Network ... $5,500.00
Analyzer; fourth detector input option
HP R85026A WR28 Detector, ... $1,200.00
26.5-40 GHz, for HP 8757 series
WILTRON 560-98KF50 SWR ... $1,800.00
Autotester, 10 MHz-40 GHz, for Wiltron 560 series

SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., ... $1,900.00
0.1-1050 MHz, 10 Hz res., GPIB
FLUKE 6060B/AK Synthesized ... $1,900.00
Signal Gen., 0.1-1050 MHz, 10 Hz res.
FLUKE 6062A Signal Generator, ... $4,500.00
0.1-2100 MHz, 10 Hz res., GPIB
GIGATRONICS 1018 Synthesized ... $4,500.00
Signal Gen., 50 MHz-18 GHz, 1 MHz res.
GIGATRONICS 600/6-12 Synthesized ... $2,500.00
Source, 6-12 GHz, 1 kHz res., GPIB
GIGATRONICS 840-18 Freq. Multiplier, ... $2,750.00
18-26 & 26-40 GHz outputs 0 dBm
GIGATRONICS 875/50 Levelled Multiplier, ... $2,500.00
x4, 50.0-75.0 GHz output, -3 dBm
GIGATRONICS 875/86 Levelled Multiplier, ... $3,750.00
26.5-40.0 & 50.0-75.0 GHz outputs
GIGATRONICS 900/2-8 Synthesized ... $2,500.00
Signal/Sweep Gen., 2-8 GHz, 1 MHz res.,GPIB
HP 11707A Test Plug-in for HP 8660 series ... $500.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio ... $450.00
HP 85100V Frequency Mult., ... $3,750.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B Signal Generator, ... $950.00
0.5-512 MHz, AM, FM, pulse modulation
HP 8656A-001 Signal Generator, ... $1,600.00
0.1-990 MHz, 100 Hz res., HPIB, OCXO
HP 8657A-002 Signal Generator, ... $3,250.00
0.1-1040 MHz, 10 Hz res., HPIB
HP 8660C/86602A/86632B ... $2,500.00
Synth. Sig. Gen., 1-1300 MHz, AM / FM
HP 8660C/86603A/86633B ... $3,250.00
Synthesizer, 1-2600 MHz, 1 Hz res., AM / FM
HP 8672A Synthesized Signal ... $5,500.00
Generator, 2-18 GHz, +3 dBm output
HP 8673G-004,008 Synth. CW ... $12,500.00
Signal Generator, 2-26 GHz, >+8 dBm output
HP 8684B Signal Generator, ... $3,500.00
5.4-12.5 GHz, AM/ WBFM/ Pulse

SWEEP GENERATORS

HP 8350A/83540A-002,004 Sweep ... $4,000.00
Oscillator, 2.0-8.4 GHz, 70 dB step attenuator
HP 8350A/83545A-002 Sweep ... $4,000.00
Oscillator, 5.9-12.4 GHz, 70 dB step attenuator
HP 8601A Generator/Sweeper, ... $400.00
0.1-110 MHz, +20 dBm levelled
HP 8620C Sweep Oscillator Frame ... $550.00
HP 86222B-002 RF Plug-in, ... $1,250.00
10-2400 MHz, +13 dBm levelled, 70 dB atten.
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled ... $375.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled ... $300.00
HP 86245A-001 RF Plug-in, 5.9-12.4 GHz, +17 dBm levelled ... $600.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled ... $500.00
HP 86260A-H04 RF Plug-in, ... $500.00
10.0-15.0 GHz, +10 dBm unlevelled
HP 86290A-004 RF Plug-in, 2.0-18.0 GHz, ... $1,750.00
+7 dBm levelled, rear output
WAVETEK 962 Sweep Generator, ... $1,250.00
1.0-4.0 GHz, markers, +12 dBm unlvld.
WILTRON 6647M Sweep Generator, ... $4,500.00
10 MHz-20 GHz, +10 dBm levelled

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, dBm ... $2,500.00
75-110 GHz (WR10), -20 to +20
BOONTON 42B/41-4E Analog ... $450.00
Power Meter, with 1 MHz-18 GHz sensor
HP 435B/8481A Power Meter, ... $900.00
-30 to +20 dBm, 10 MHz-18 GHz
HP 435B/8481B Power Meter, ... $1,500.00
0 to +43 dBm, 10 MHz-18 GHz
HP 435B/8482H Power Meter, ... $900.00
-10 to +34 dBm, 100 kHz-4.2 GHz
HP 436A-022/8481A Power Meter, ... $1,400.00
-30 to +20 dBm, 10 MHz-18 GHz, HPIB
HP 436A-022/8484A Power Meter, ... $1,400.00
-70 to -20 dBm, 10 MHz-18 GHz, HPIB
HP 8477A Power Meter Calibrator, for HP 432 series ... $500.00
HP Q8486A Power Sensor, ... $1,500.00
33.0-50.0 GHz, WR22, for 435/6/7/8
HP R8486A WR28 Power Sensor, ... $1,500.00
26.5-40 GHz, for HP 435/6/7/8

RF MILLIVOLTMETERS

RACAL 9303 TRMS Level Meter, ... $875.00
10 kHz-2 GHz, -77 to +23 dBm, GPIB

AMPLIFIERS, MISCELLANEOUS

ENI 1040L Amplifier, 55 dB gain, 10-500 kHz, 400 Watts ... $2,750.00
HP 11729B-003 Carrier Noise Test Set, 5 MHz-3.2 GHz ... $2,250.00
HP 415E SWR Meter ... $200.00
HP 8406A Comb Generator, ... $500.00
1/ 10/ 100 MHz increments, to 5 GHz
HP 8447A Amplifier, 20 dB, ... $375.00
0.1-400 MHz, 5 dB NF, +6 dBm output
HP 8447D-001 Dual Preamplifier, ... $900.00
26 dB, 0.1-1300 MHz, NF<8.5 dB
HP 8447E Amplifier, 22 dB, ... $750.00
0.1-1300 MHz, +13 dBm output
HP 8447F-H64 Dual Amp., ... $900.00
25 dBG 0.1-1300 MHz & 28 dBG 9 kHz-50 MHz
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz ... $2,500.00
HP 8901B-1,2,3 Modulation An., ... $3,000.00
0.15-1300 MHz, rear input, OCXO, ext.LO
HP 8970A Noise Figure Meter ... $4,000.00
HUGHES 1177H10F000 TWT Amplifier, ... $2,500.00
>30 dB gain, 1.4-2.4 GHz, 20 Watts
HUGHES 8010H13F000 TWT Amplifier, ... $2,500.00
>30 dB gain, 3-8 GHz, 10 Watts
HUGHES 8020H01F000 TWT Amplifier, ... $4,250.00
>30 dB gain, 2-4 GHz, 20 Watts
RF POWER LABS ML50 Amplifier, ... $350.00
2-30 MHz, 47 dB gain, 50 Watts, metered, 28V
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz ... $3,750.00

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 ... $95.00
Cavity Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) *NEW*
AVANTEK AMT-400X2 WR28 Active ... $450.00
Doubler, 13-20 GHz +10 dBm in, +10 dBm out
BAYTRON 3-28-300/10 WR28 Directional ... $300.00
Coupler, 10 dB, 26.5-40 GHz
BIRD 6735-300 1 kW Load, ... $650.00
25-1000 MHz, LC(f), with wattmeter
BIRD 8201 500 Watt Oil Cooled Load, DC-2.5 GHz, N(f) ... $350.00
BIRD 8251 1 kW Oil-Dielectric Load, DC-2.4 GHz, N(f) ... $500.00
CONTINENTAL MW. ... $225.00
RAE28-K-M WR28 x K(m) Endfire Adapter
FXR/MICROLAB S3-02N Triple Stub ., N(m/f) ... $125.00
Tuner, 200-1000 MHz, 100 Watts max
FXR/MICROLAB SL-03N Stub Tuner,) ... $75.00
0.3-6.0 GHz, 100 Watts max., N(m/f
GR 874-LTL Constant Impedance ... $400.00
Trombone Line, 0-44 cm, DC-2 GHz
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ... $450.00
HP 11636A 2-Way Power Divider, DC-18 GHz, N(m/f/f) ... $300.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz ... $800.00
HP 33321K Programmable Step Atten., ... $475.00
0-70 dB, DC-26.5 GHz, 3.5mm
HP 33327L-006 Programmable Step ... $1,000.00
Attenuator, 0-70 dB, DC-40 GHz, 2.9mm
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz ... $275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz ... $275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, t ... $450.00
100-2000 MHz, APC7 test por
HP 83017A Amplifier, ... $3,250.00
25 dB gain, 0.5-26.5 GHz, >+15 dBm
HP 8431A 2-4 GHz Band Pass Filter, N(m/f) ... $150.00
HP 8472A Crystal Detector, ... $175.00
10 MHz-18 GHz, negative polarity, SMA
HP 8494G-002 Programmable ... $350.00
Step Attenuator, 0-11 dB, DC-4 GHz, SMA
HP 8495H-001 Programmable Step ... $400.00
Attenuator, 0-70 dB, DC-18 GHz, N
HP 8496A-002 Step Attenuator, ... $375.00
0-110 dB, DC-4 GHz, SMA
HP 8497K-004 Programmable ... $750.00
Step Attenuator, 0-90 dB, DC-26.5 GHz
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz ... $350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz ... $450.00
HP K752C WR42 Directional Coupler, 10 dB, 18.0-26.5 GHz ... $450.00
HP K752D WR42 Directional Coupler, 20 dB, 18.0-26.5 GHz ... $450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz ... $275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz ... $300.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz ... $650.00
HP R382A WR28 Direct Reading ... $2,250.00
Attenuator, 0-50 dB, 26.5-40 GHz
HP R422A WR28 Crystal Detector, 26.5-40 GHz ... $400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz ... $500.00
HP R752C WR28 Directional Coupler, 10 dB, 26.5-40 GHz ... $450.00
HP R752D WR28 Directional Coupler, 20 dB, 26.5-40 GHz ... $450.00
HP R914B WR28 Moving Load, 26.5-40 GHz ... $250.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz ... $750.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz ... $650.00
HP X870A WR90 Slide Screw Tuner ... $150.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz ... $900.00
HUGHES 45714H-1000 WR15 Frequency Meter, 50-75 GHz ... $900.00
HUGHES 45716H-1000 WR10 Frequency Meter, 75-110 GHz ... $900.00
HUGHES 45721H-2000 WR28 GHz ... $1,000.00
Direct Reading Attenuator, 0-50 dB, 26.5-40
HUGHES 45724H-1000 WR15 Direct ... $1,000.00
Reading Attenuator, 0-50 dB, 50-75 GHz
HUGHES 45732H-1200 WR22 Level ... $250.00
Set Attenuator, 0-25 dB, 33-50 GHz
HUGHES 45772H-1100 WR22 Thermistor ... $400.00
Mount, -20 to +10 dBm, 33-50 GHz
HUGHES 45773H-1100 WR19 Thermistor ... $650.00
Mount, -20 to +10 dBm, 40-60 GHz
HUGHES 45774H-1100 WR15 Thermistor ... $750.00
Mount, -20 to +10 dBm, 50-75 GHz
HUGHES 45775H-1100 WR12 Thermistor ... $800.00
Mount, -20 to +10 dBm, 60-90 GHz
HUGHES 45776H-1100 WR10 Thermistor ... $850.00
Mount, -20 to +10 dBm, 75-110 GHz
HUGHES 47316H-1111 WR10 Tuneable ... $600.00
Detector, 75-110 GHz, positive polarity
HUGHES 47741H-2310 WR28 Phase ... $2,000.00
Locked Gunn Osc., 32.000 GHz, +18 dBm
HUGHES 47742H-1210 WR22 Phase ... $2,750.00
Locked Gunn Osc., 42.000 GHz, +18 dBm
HUGHES 47974H-1000 WR15 ... $375.00
SPST PIN Switch, 250 MHz speed, 60-62 GHz response
KRYTAR 2616S Directional Detector, ... $200.00
1.7-26.5 GHz, K(f/m)/SMC
M/A-COM 3-19-300/10 WR19 ... $450.00
Directional Coupler, 10 dB, 40-60 GHz
MICA C-121S06 Circulator, 17.5-24.5 GHz, SMA(f/m/m) ... $75.00
MIDWEST MICROWAVE 3537 ... $40.00
DC Block, 0.1-12.4 GHz, SMA (m/f) *NEW*
MINI-CIRCUITS ZFDC-20-4 ... $25.00
Directional Coupler, 19.5 dB, 1-1000 MHz, SMA(f)
NARDA 3000-SERIES Directional Couplers ... $150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz ... $375.00
NARDA 3090-SERIES Precision High Directivity Couplers ... $225.00
NARDA 368BNM Coaxial High ... $500.00
Power Load, 500 Watts, 2.0-18 GHz, N(m)
NARDA 3752 Coaxial Phase Shifter, ... $1,000.00
0-180 deg./GHz, 1-5 GHz
NARDA 3753B Coaxial Phase Shifter, ... $1,000.00
0-55 deg./GHz, 3.5-12.4 GHz
NARDA 4000-SERIES SMA Miniature ... $75.00
Directional Couplers
NARDA 4226-10 Directional Coupler, ... $275.00
10 dB, 0.5-18.0 GHz, SMA(f)
NARDA 4227-16 Directional Coupler, ... $325.00
16 dB, 1.7-26.5 GHz, 3.5mm(f)
NARDA 4242-20 Directional Coupler, ... $100.00
20 dB, 0.5-2.0 GHz, SMA(f)
NARDA 4247-20 Directional Coupler, ... $200.00
20 dB, 6.0-26.5 GHz, 3.5mm(f)
NARDA 4247B-10 Directional Coupler, ... $200.00
10 dB, 6.0-26.5 GHz, 3.5mm(f)
NARDA 5070-SERIES Precision ... $300.00
Reflectometer Couplers
NARDA 562 DC Block, 10 MHz-12.4 GHz, 100 V max., N(m/f) ... $65.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) ... $165.00
NARDA 768-10,-20 10 dB or 20 dB Attenuator, ... $120.00
20 Watts, DC-11 GHz, N(m/f)
NARDA 792FF Variable Attenuator, ... $375.00
0-20 dB, 2.0-12.4 GHz
NARDA 794FM Direct Reading ... $375.00
Variable Attenuator, 0-40 dB, 4-8 GHz
OMNI-SPECTRA 2085-6010-00 ... $50.00
Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f)
PAMTECH KYG1014 WR42 ... $250.00
Junction Circulator, 18.0-26.5 GHz
SONOMA SCIENTIFIC 21A3 WR42 ... $75.00
Circulator, 20 dB, 20.6-24.8 GHz
TRG B510 WR22 Direct Reading ... $1,000.00
Attenuator, 0-50 dB, 33-50 GHz
TRG V551 WR15 Frequency Meter, 50-75 GHz ... $600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz ... $750.00
WAVELINE 100080 WR28 B ... $200.00
Terminated Crossguide Coupler, 30 d
WEINSCHEL DS109 Double ... $150.00
Stub Tuner, 1-13 GHz, N(m/f)
WEINSCHEL DS109LL Double ... $150.00
Stub Tuner, 0.2-2.0 GHz, N(m/f)

COMMUNICATIONS

HP 3780A-001 Pattern Generator / ... $1,000.00
Error Detector, 1 kb/s - 50 Mb/s
HP 59401A HPIB Bus Analyzer ... $375.00
MICRODYNE 1200MR 215-320 MHz n ... $750.00
Telemetry Receiver, PSK demodulatio
TEK 1410R NTSC Gen., w/SPG2 sync. ... $800.00
generator, TSG7 color bars
TEK 1411R PAL Gen.,w/SPG12 sync; ... $750.00
TSG11 color bars;TSG13 linearity
TEK 1411R PAL Test Gen., ... $1,000.00
w/SPG12,TSG11,TSG13,TSG15,TSG16
TEK 1411R PAL Test Gen., ... $1,100.00
w/SPG12,TSG11,TSG12,TSG13,TSG15,TSG16
TEK 1411R-opt.04 PAL Test Gen., ... $1,400.00
w/SPG12,TSG11,TSP11,TSG13,TSG15,TSG16
TEK 147A NTSC Test Signal ... $800.00
Generator, with noise test signal
TEK 148 PAL Insertion Test Signal Generator ... $700.00
TEK 520A NTSC Vectorscope ... $750.00
TEK 521A PAL Vectorscope ... $750.00

MISCELLANEOUS

FLUKE 2180A RTD Digital Thermometer ... $500.00
HP 7090A Measurement Plotting System ... $1,500.00
P.A.R. 5206-95,98 Two-Phase ... $1,500.00
Lock-in Amp., 2 Hz-100 kHz, GPIB
TEK TM5003 5000-series 3-slot ... $450.00
Programmable Power Module
TEK TM5006 5000-series 6-slot ... $600.00
Programmable Power Module
TEK TM504 500-series 4-slot Power Module ... $175.00
TEK TM506 500-series 6-slot Power Module ... $250.00
TEK TM515 500-series 5-slot Traveller Power Module ... $250.00

Write In 62 on Reader Service Card.

C and H SALES COMPANY

2176 E. Colorado Blvd. • Pasadena, CA 91107

TOLL FREE: 1-800-325-9465

FREE 148 PAGE CATALOG!

C & H SALES COMPANY HAS BEEN IN BUSINESS FOR OVER FIFTY YEARS. WE'RE THE BEST SOURCE FOR GREAT BUYS ON ITEMS LIKE THESE - AND MORE!

ELECTRONIC COUNTER
HEWLETT PACKARD, Model 5328A. Universal counter. Usable to 100 MHz, 100 ns single shot resolution. Has frequency, period, period average, ratio, totalize, scale functions. A built-in digital voltmeter allows measurements of input voltages. Two input channels provide individual slope, polarity and level settings. Has 9 digit LED readout. Input power 100–240 VAC 48–66 Hz 100 VA max. Dimensions: 17" wide x 17-1/4" deep x 3-1/2" high.

Stock #TE9808 **$250.00**

SOLA CONSTANT VOLTAGE TRANSFORMER

SOLA ELECTRIC, #93-13-150. Harmonically neutralized constant voltage transformer. Rated at 500 watts. Input voltage 95 to 130 VAC 60 Hz. Output voltage 120 VAC. This unit is designed for rack or bench mounting. The meters on the front panel indicate output current and input/output voltage. A toggle switch is provided for selection of input or output voltage. The input voltage is connected at the rear of the unit via a covered electrical panel. Two standard 3-wire grounded electrical outputs are supplied on the front and rear panels. Dimensions: 19" wide x 14-1/4" high x 10-1/4" deep. Weight 59 lbs.

Stock #STR9900 **$225.00**

MILLIOHMETER
HEWLETT PACKARD, Model 4328A. Designed to measure very low resistances. Measurement range 1m ohm to 100 ohms. Resolution 20 u ohms. Analog meter readout. Ideal for measuring contact resistance of switches or relays. This unit is also useful for measuring the resistivity of semi-conductor devices. (Requires special 4 terminal probes which are not supplied, but probably are available from Hewlett Packard.) Power input: 115–230 VAC 48–66 Hz, 5 VA max. Dimensions: 5-1/8" wide x 11-1/2" deep x 6-1/2" high.

Stock #TE9812 **$200.00**

ALTIMETER/BAROMETER
KOLLSMAN, #MC-2 MS28074-2. Scale type altimeter with barometric setting scale window. Altimeter scale range –1000 to 80,000 feet. Barometric range 28.1 to 31.0 inch of mercury. An adjustment knob is provided for scale setting to local altitude or barometric pressure. Has white numerals on a black background. Illumination is provided. Electrical input is rated 115 VAC 400 cycles. Pressure input port is female 7/16"X20 thread. Standard aircraft panel 3-1/8" mount. Dimensions: 2-17/64" sq. x 7-1/2" deep.

Stock #STOCK #IN9900 **$79.50**

☑ Master Charge ☑ Visa ☑ American Express ☑ Discover

Call us first if you have surplus inventories of electronic, optical, or mechanical items for disposal

WE BUY & SELL!

Write in 68 on Reader Service Card

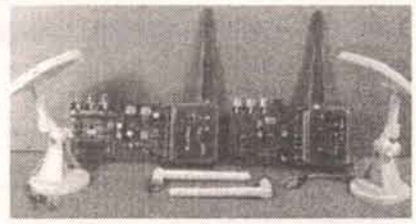
HAM GEAR FOR SALE

LML RADIO & electronics. Let us be your one stop shop for all your used radio equipment, test equipment & other surplus stuff. For catalog, call 909-873-1319 or fax on demand 24 hr. 909-820-1885 & our web catalog: Http://members.aol.com/hrh6/LMLinc or LML, 424 E. Shamrock, Rialto, CA 92376.

THE SMART BATTERY CHARGER for lead acid or gel cell batteries. Can be left connected to the battery **INDEFINITELY**, will not overcharge! Standard kit is 12V @ 1 amp. This kit is 100% complete. For the kit order #150-KIT at $59.95. For an assembled and tested unit, order #150-ASY at $79.95. CA residents add 7.75% sales tax. Add $6.50 per unit shipping. MC/VISA accepted. A&A Engineering, 2521 W. La Palma #K, Anaheim, CA 92801. 714-952-2114, FAX 714-952-3280.

MIKEMASTER: A microphone preamplifier with noise gating & compression. Created by Marv Gonsior W6FR, March 1998 QST. Got noise get MikeMaster! For kit order #210-KIT at $69.95. Assembled & tested (specify Kenwood, ICOM, or Yaesu wiring) order #210-ASY at $89.95. Shipping for US & Canada is $6.50, others add 15%. CA residents add 7.75% sales tax. For info send legal size SASE to A&A Engineering, 2521 W. LaPalma #K, Anaheim, CA 92801. P 714-952-2114, Fax 714-952-3280.

WANTED: ROCKWELL-Collins HF-80 equipment, 851S-1, 237B-3 log periodic, Collins literature. Jim Stitzinger 805-259-2011, 805-259-3830 (fax), bfl-jfs@smartlink.net



ATV-2400, 2.4GHz 8 channel designed for legal use in ham bands. EZATV, www.4atv.com

FOR SALE: ORBIT 360 antenna rotator. Full instructions. Never used, $40 obo. 949-494-0072.

30KW RF GENERATOR design by Westinghouse WL6426 water cooled tube 50KW, under transmitter conditions. Mike 828-684-7672. HTTP://WWW.CHIGEOR@AOL.COM

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

HAM GEAR WANTED

ARC-5 RECEIVERS and original manuals. John Broussard, 312 Guilbeau, Breaux Bridge, LA 70517.

RESPONSE TO earlier ads have netted me 50 ARC5 receivers. I would like to have 50 more receivers. Prefer original, unmodified receivers, but will consider any condition. John Broussard, 312 Guilbeau, Breaux Bridge, LA 70517.

CB – SCANNERS

SALES & SERVICE: CB equipment, modification kits, meters, antennas, mics, radios, transistors, repairs & hard-to-find items. Complete list $4. D&R Electronics, 10 Park St., Thomaston, CT 06787. 860-283-9492 or RTed821836@aol.com

HALCON COMMUNICATIONS Wholesale only: Cobra, Uniden, Midland, Galaxy, CTE, Super Star, Kenwood, Yaesu, Icom. Free catalog, Free call 1-800-683-6999.

CB MODIFICATIONS! Frequencies, books, kits, high-performance accessories, plans, repairs, amplifiers, 10-meter conversions. The best since 1976! Catalog $3. CBCI, Box 1898NV, Monterey, CA 93942. www.cbcintl.com

240+ CHANNEL CB/HAM/COMMERCIAL radios: AM/FM/SSB/CW export/domestic: RCI, Motorola, Uniden, Cobra, Alinco, Kenwood. Mics, antennas, linears, meters, books, night scopes, and tons more stuff! Catalog $3. MAXTECH, Box 8086, New York, NY 10150. 718-547-8244.

SHOOTING STAR, Palomar, Superstar, Galaxy, Uniden, Cobra, exports, police & fire & military scanners, microphones, power supplies, antennas, modifications, repairs, more!! 15 yrs. in same location, 5 page picture price sheets $1 (refundable). Galaxy, Box 1202, Akron, OH 44309. (Also, Red Devil & Messinger Products.)

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT

Visit www.alfaelectronics.com for complete info
Call 1-800-526-2532 for Order and Free Catalog

DMM

- **DMM-89S** ($179.00): true rms, AC/DC (V,A), Ω, bar graph, freq, capac., dBm, logic, diode
- **DMM-23T** ($99.95): 4½ digit, true rms, high resol. (10µV, 10nA, 10mΩ), hFE, diode, contin.
- **DMM-20** ($74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω, hFE, diode, duty cycle
- **DMM-122** ($59.95): DC/AC(V,A), Ω, hFE, diode, capacitance, freq, logic, continuity
- **DMM-123** ($44.95): DMM + capacitance, DC/AC(V,A), Ω, hFE, diode, continuity
- **DMM-10** ($19.95): 3½ digit, DC/AC V, Ω, hFE, diode, signal output(+3V,-0.5Vsq.,50%duty)

LCR /COUNTER

- **CAP-15** (*$49.95*): 3½ digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment.
- **LCR-24** (*$119.95*): 0.1µH-200H, 0.1pF-2000µF, 0.01Ω-20MΩ, diode test. *New Model.*
- **LCR-131D** (*$219.95*): autorange, 0.1µH-10kH, 0.1pF-10mF, 1mΩ-10MΩ, Q Factor, serial/parallel, 120Hz/1kHz testing mode.
- **FC-1200** (*$129.95*): 1.25GHz counter Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz)

FLUKE

12B	$ 94.95
70-III	$ 99.00
73-III	$125.00
75-III	$155.00
77-III	$173.00
79-III	$195.00
87-III	$325.00
92B-III	$1,445
96B-II	$1,695
99B-III	$2,095
105B	$2,495
123-III	$1,130
863E	$555
867B	$740

SPECIALTY

• AC Current Probe	$34.95
• DC/AC Current Probe	$79.95
• Mini AC Clamp	$59.95
• AC Clamp w/temp	$89.95
• DC/AC Clamp	$109.95
• Thermometer	$69.95-$89.95
• IR Thermometer	$189.95
• Sound Level Meter	$169.95
• Tachometer	$169.95-$219.95
• EMF Tester	$69.95
• Pressure Meter	$299.95
• Watt Meter	$129.95
• High Voltage Probe	$59.95
• pH Meter	$79.95
• Light Meter	$79.95-$89.95

Single Output DC Power Supplies

- Constant current, constant voltage mode
- Short Circuit and overload protected

Analog Meters Display	*Digital Volt, Analog Current*
PS-303 ($159.00) 30V/3A	PS-8200 ($179.95) 30V/3A
PS-305 ($219.95) 30V/5A	PS-8201 ($239.95) 30V/5A
PS-8112 ($399.95) 60V/5A	*Digital Volt & Current Display*
PS-1610 ($289.00) 16V/10A	PS-8300 ($199.95) 30V/3A
PS-8107 ($399.95) 30V/10A	PS-8301 ($259.95) 30V/5A

Triple Output

- Independence or Tracking operation
- Parallel to double current output (PS-8102 & PS-8103 only)

Triple Output (Analog displays)
PS-8102 ($399.95) 30V/3A/30V/3A
PS-8103 ($489.95) 30V/5A/30V/5A
Digital Displays
PS-8202 ($499.95) 30V/3A/30V/3A
PS-8203 ($549.95) 30V/5A/30V/5A

AUDIO/RF/FUNCT. GEN.

RF Generator • **SG-4160** ($124.95) 100kHz-150MHz sinewaves in 8 ranges
• **SG-4162AD**($229.95) with 6 digit counter
Audio Generator • AG-2601 ($124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave
• **AG-2603AD** ($229.95) with 6 digit counter
Function Generator • **FG-2100A ($154.95)** 0.2Hz-2MHz,5mV-20V$_{pp}$
• **FG-2103** ($329.95) *Sweep* 0.5Hz-5MHz

GW/INSTEK®

20 MHz Scope | **100MHz Cursor** | **DC POWER SUPPLIES: Triple Output, Single Output, Programmable** | **FUNCTION GENERATOR** | **BENCHTOP DMM**

• OS-620 $304.95
- Most economical scope
- Dual CH/X-Y operation
- 1 mV/div sensitivity
- Z-axis input,CH1 output
- TV syn, ALT trigger
- 2 probes (x1, x10)

• OS-6103 $1199.95
- **Cursor Readout & meas**
- Dual CH / Delay sweep
- 10 panel setting memory
- Time base auto-range
- Z-axis modulation input
- 2 probes (x1, x10)

- 2 variable out 0-30V,0-3A
- One fixed 5V,3A output
- Auto track, serial, parallel
- Const. volt, current mode
- 4 analog or 2 digital display

PC-3030 ($499.95)
PC-3030D ($549.95) digital

- Const voltage, current mode
- Voltage regulation ≤0.01%
- Current regulation ≤0.2%

PS-1830 ($198.95) 18V/3A
PS-1850 ($214.95) 18V/5A
PS-1830D($214.95)18V/3A
PS-1850D($244.95)18V/5A

- Auto serial/parall.(PPT ser)
- Auto track (PPT series), IEEE-488.2 and SCPI compatible command set

PPS-1860G($1,149.95)18V/6A
PPS-3635G($1,149.95)36V/3.5A
PPT-1830G($1,499.95)18V/3A
PPT-3615G($1,499.95)36V1.5A

FG-8015G ($157.95)
- 0.02Hz-2MHz
- Sine/Squ/Tri/Pulse/Ramp

FG-8020G ($209.95)
- 0.02Hz-2MHz w/counter

FG-8050 ($449.95) Sweep
- 0.05Hz-5MHz w/counter
- INT/EXT AM/FM mod

DM-8034($179.95) 3½ dgt
- AC/DV(V,A),C,Ω,diode

DM-8040($339.95) 3¾ dgt
- ACV to 50kHz, true rms

DM-8055G($889.95)5½dgt
- 0.006% accuracy, GPIB
- dBm,auto,REL, min/max

ALFA ELECTRONICS
P.O. BOX 8089
PRINCETON, NJ 08543-8089

TEL: (800)526-2532 / (609) 897-1135
FAX: 609-897-0206
E-mail: sales@alfaelectronics.com

Call / Write / Fax / Email for FREE CATALOG
Visa, MC, AMEX, COD, PO Accepted. OEM Welcome.
1 Year Warranty (2 Years for GW/Instek)

Write in 69 on Reader Service Card.

KONNEX DISTRIBUTING. Call 1-888-777-7874. PO Box 451372, Los Angeles, CA 90045. CBs, antennas, meters, transistors. Best prices. Credit card acceptable.

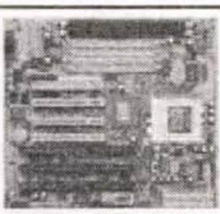
MUSIC & ACCESSORIES

COMPUTER HARDWARE

CRTs CHEAP. Buy direct from the manufacturer. Save money. Mfg. all CRT types since 1950. **3 year warranty**. Reg-Res 19" tubes $75; 25" $100; hi-res 13" tubes from $80. We specialize in **hi-resolution** video/computer CRTs. **T.M.C.** 215-226-0749/215-223-0388.

433MHz PII system with Intel CELERON/A 128K cache MMX CPU, 4.3 gigabyte hard drive, 48X CD-ROM, 1.44 floppy, 32 megabytes SDIMM memory, 8MB AGP 3D video, 56K modem/voice/fax, 32 voice 3D sound, 360 watt speakers, multimedia keyboard, Internet mouse, ATX case, 2 year parts and labor warranty! Only $499! Everything installed with FULL versions WIN95B $39, WIN98SE $119. Other upgrades and add-ons available for a custom system. Order now 847-657-1160 or on-line www.saveware.com

SONY PLAYSTATION GAME ENHANCER, mod-chip function plays backup COPY of CD. You do not need to have original loaded to play backup. Simply plug the enhancer in back of playstation! Skips both Sony logos, many preloaded cheat codes. Memory management, view video/movie files from CD, PC computer link port $29. Quantity prices available. 240 save game memory card $25. Stealth MOD-CHIP $19. Order now 847-657-1160 or on-line www.saveware.com



433MHz INTEL CELERON/A 128K cache CPU and Pentium II motherboard super combo deal including AGP 3D 8MB video, 3D 32 voice PCI digital sound, 1 floppy, 2 UDMA/33/66 IDE, serial/parallel, USB, IF and PS2 ports, 56K modem/FAX/voicemail, 10/100 LAN, ATX or normal power connectors, CD-ROM disc w/drivers & many FREE applications, 2 year motherboard warranty, only $179. Order now 847-657-1160 or www.saveware.com

450MHz BAREBONE systems from $250. 486 computers $99. Brand name Pentiums from $199. Motherboards $20, 1.44/1.2 floppies, speakers $10. 714-778-0450.

LOW-COST 12-BIT A/D KITS. $59 LPT: Analog! PC printer-port interface acquires 8 analog signals. Also features two 12-bit D/As, current sources for sensor excitation and digital I/O lines. QuickBasic and VB software included. 1-channel A/D only $39. http://www.tgn.net/~adnav/ or E-Mail: adnav@tgn.net

LOOKING FOR cheap clone PC parts that actually work? Call UTWE for CD ROMs, hard drives, disk controllers, video cards, mainboards, CPUs, etc. For example, NEW clone-o-matic mainboard with 4 PCI, 4 ISA, 256K cache, I/O built on board with 200MHz AMD, $70. 486 all-in-one mainboard (video and IDE IO), $35 ea. Remember, today we have it, tomorrow we don't! 56K ISA PnP WinModem by Multitech, $20. Case of 7 nearly new Epson keyboards, $21 ($3 ea.). There are other deals too! For the latest dealsheets, E-Mail: dealsheets@utwe.com or call 626-930-1121 (10am-5pm Pacific) or fax 626-930-1123, E-Mail: sales@utwe.com

WE CARRY a variety of cables, switch boxes, accessories, and adapters to connect PCs, printers, Mac's, networks, telecommunications, and audio/video equipment. We offer: custom cables, free catalogs, and same day shipping on most orders. Visit our website at www.rogerssystems.com or call 1-800-366-0579.

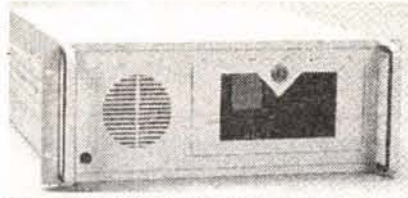
PC CABLES: http://www.cablesusa.com 100s of hard-to-find new cables and parts, pictures, free technical information. Low prices, RS232, SCSI, keyboard, network, VGA, Cat-5, USB, Firewire, fast secure online ordering & browsing. 954-418-0817.

SMARTCARD PROGRAMMER READ & WRITE to ANY ISO-7816 device! *This ISO-7816 programmer is fully assembled and tested. The following is included: 1. Programmer module. 2. RJ11 data cable. 3. Com port adapter (com1 or 2). 4. UL approved power supply. Easy to understand instruction page. For IBM computers only, user must have a DX386 or better machine and use of the Internet. ONLY $149.95 plus S/H. TO order, call 231-882-4079. *Type of software will allow programmer to work with any ISO-7816 device. Software nor ISO-7816 devices are not provided, user must procure software and ISO-7816 devices. 90 day hardware warranty included!

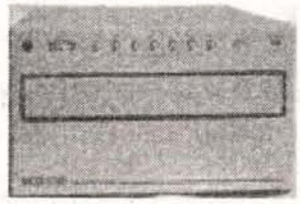
EVERYTHING NEW w/warranty! Motherboards with CPU 450MHz $195, monitors 15" $125, Pentium systems from $195. Modems, multimedia kits, scanners, hard drives 540 megabytes $35, 2.5 gigabytes $65. Call 714-778-0450. E-Mail: cci@surfside.net

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

WINDOWS 95B only $49! Includes CD, boot floppy, and certificate. (Super Price!) Windows 98SE only $119! Includes CD, manual, boot floppy, and certificate. (Second Edition!) Order now 847-657-1160 or on-line www.saveware.com



19" RACKMOUNT ATX PC chassis, $169 (with ad). 972-242-8087, www.cti-tx.com



14 NAKAMICHI MBR-7 2X SCSI 7 Disc Jukebox Changer, and 6 foot SCSI 50 pin Centronics cable. For the PC and has RCA jacks for MUSIC CD's too, $100 each. 847-657-1160!

TOSHIBA 2100 laptop, 486 50MHz Intel processor, thumb mouse, 12 megabytes of memory, 260 megabyte hard drive, 1.44 floppy drive, 2 type II PCMCIA slots or 1 type III, parallel port, serial port, external PS/2 keyboard port (can supply PS/2 to PC keyboard adapter for $1), and SVGA video port to hookup external SVGA monitor. Bright black and white display. Toshiba software and Win 3.11, Microsoft Word, more. Battery and power cable included, $160. 847-657-1160.

Tired of Expensive Inkjet Cartridges ?

Save 90% on Inkjet Inks !

Printer	# of Refills Black	# of Refills Color	Cost/Refill Black	Cost/Refill Color	Kit Price Black	Kit Price Color
HP 500 Series, 400, Officejet 300, 350, Fax	7	14	**4.71**	**2.85**	32.95	39.95
HP 600 Series, Officejet 500, 570, 600	7	14	**4.71**	**3.21**	32.95	44.95
HP 820C, 855C, 870C, 1000C, 1150C, Copier 120, 210	6	12	**6.67**	**3.33**	39.95	39.95
HP 720C, 722C, 712C, 880C, 890C, 895C 1120C, 1170C	6	12	**6.67**	**3.75**	39.95	44.95
Canon BJ-10, 200, 210, 240, 250 Apple SWriter 1200, 1500	14	20	**2.15**	**2.00**	29.95	39.95
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	60	60	**0.50**	**0.67**	29.95	39.95
Canon BJC-6000	**14**	**8**	**2.85**	**1.67**	**39.95**	**39.95**
Canon BJC-600, 610, 620 Apple SWriter Pro	20	13	**1.50**	**3.07**	29.95	39.95
Epson Stylus Color, Color Pro, Pro XL	12	12	**2.50**	**3.33**	29.95	39.95
Epson Stylus Color II, IIs, 1500 (Black)	15	15	**2.00**	**2.66**	29.95	39.95
Epson Stylus Color 500, 200	20	17	**1.50**	**2.35**	29.95	39.95
Epson Stylus Color 400, 600, 800, 850, Photo	20	17	**1.50**	**2.65**	29.95	44.95
Lexmark JP 1000, 1020, 1100, ExecJet II, IIc, Medley 4C	10	17	**3.00**	**2.35**	29.95	39.95
Lexmark JetPrinter 5700, 5000, 7000, 7200, 3200	15	17	**2.67**	**2.35**	39.95	39.95
Compaq IJ700, IJ900, Xerox XJ8C, XJ9C	15	17	**2.67**	**2.35**	39.95	39.95
Xerox Home Center 450C, XJ6C Inkjet	22	12	**1.36**	**3.33**	29.95	39.95

SAVE 30 - 50% on New Compatible Cartridges!

Printer (CALL FOR OTHERS NOT LISTED)	BLACK CARTRIDGE	COLOR CARTRIDGE
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	$5.50	$12.95
Apple StyleWriter 2400, 2500	$5.50	$12.95
Canon BJC-600, 610, 620 Apple StyleWriter Pro	$4.95 (9cc)	$4.95 @ (9cc)
Hi-Capacity Canon BJC-600, 610, 620	**$5.95 (15cc)**	**$5.95 @ (12cc)**
Canon BJC-70, BJC-80	$9.95 (3-pak)	$14.95 (3-pak)
Epson Stylus Color, Color Pro, Pro XL NEW PRICING	**$10.95**	**$17.95**
Epson Stylus Color II, IIs	**$12.95**	**$17.95**
Epson Stylus Color 500, 200	**$12.95**	**$17.95**
Epson Stylus Color 400, 600, 800, 850,1520, Photo	**$12.95**	**$17.95**
Epson Stylus Color 440, 640, 740	**$12.95**	**$17.95**

- **BULK Inks, Refill Accessories**
- **Glossy card stock & Coated Paper**
- **School & Government PO's Welcome**
- **2 - 3 Day Shipping**

Quality Inks for:
HP • Epson • Lexmark
Canon • Apple • DEC

Inkjet Southwest

Call or see us online!

Monday - Friday
8:30 - 5:30 PST 11:30 - 8:30 EST

www.inkjetsw.com **1-800-447-3469**
(480) 668-1069 Fax **(480) 668-0959**

COMPUTER SOFTWARE

FREE IBM DISK CATALOG of quality Shareware and CD-ROMs. **MOM 'N' POP'S SOFTWARE** <ASP>, PO Box 15003-N, Springhill, FL 34609-0111. 352-688-9108. momnpop@webcombo.net

UNDERGROUND CDs: Health, hacking, phreaking, free energy, anti-gravity, time travel, many incredible electronic devices, and MP3 stuff: **www.hi-techstuff.com**

CAM & MOTION SW/HW: Z-trace, PCB toolpath. Plotcam motion control, step drivers. **www.megabits.net/ddt** FAX 321-452-7197, 321-459-2729. **heater@megabits.net**

LIQUIDATION WINDOWS 95/98, Office suites $10-69. 1,000 games $25. Windows 98 book $10. 714-778-0450.

COMPUTER EQUIPMENT WANTED

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935).

HP CALCULATORS wanted: models 10, 70, calculator watch, others for private collection. Cash paid. Bob Morrow, 765-855-2348, rkmorrow@aol.com

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

Write in 70 on Reader Service Card.

Lowest Dealer Price Available

	5+	10+	20+
Refurb. Panasonic 145	$45	$40	$35
Regal w/Remote	$38	$35	$30
BC4535 86 Channel	$30	$28	$25
Oak Sigma 99 Channel	$45	$40	$35
75 Channel Converter	$18	$18	$18
Zenith ST1600 w/Remote	$75	$70	$65
Panasonic Converters Model-175 (550MHz)	$65	$55	$45

Six month's warranty on this model only

Call us today to satisfy all your cable equipment needs!

SAM'S ELECTRONICS

1-405-631-1856

All Cable Equipment is unmodified.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

WANTED: TERMINALS + PRINTERS: DEC, Wyse, IBM, ADDS, Okidata, Data South, Epson, C.ITOH, etc. Call for quote on any surplus computer equipment. Call Jeremy, 603-673-8077.

WANTED: HEATHKIT resistor substitution box. Will pay. Hugh M. Adams **hugh@emcst.com** or 850-864-2414. 1011D Hondo Ave., Ft. Walton Beach, FL 32547-3823.

TEST EQUIPMENT

FEITEK PROVIDES repair, calibration and traceable certifications of test equipment. Free estimates. We buy, sell and trade all makes of test equipment. Visa and MasterCard accepted. Check out our inventory and specials at WWW.FEITEK.COM 2752 Walton Road, St. Louis, MO 63114, 314-423-1770.

KENTRONIX TEST EQUIPMENT SPECIALS. Check our WEB site at **http://www.kentronix.com** for monthly specials. We are also looking to buy test equipment, coaxial and waveguide components, manuals, etc. Contact Brian at 732-681-3229 or FAX 732-681-3312. E-Mail: brian@kentronix.com

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

POOR MAN'S Spectrum Analyzer/Monitor Receiver Kit. 2 to 1,700 MHz. Basic kit only $98. Now available with switched resolution filters, tracking generator and direct digital frequency readout. Works with ANY scope or IBM compatible computer. Send stamped envelope for details. Science Workshop, Box 310B, Bethpage, NY 11714. http://www.science-workshop.com

TEST EQUIPMENT: HP 3585A spectrum analyzer $3,500; HP 141T/8552B/8553B $650; HP 8443A $165; HP 5327C counter $40. 301-977-7408.

TEST EQUIPMENT for sale/wanted (NEW/USED): RF, Microwave, video and fiber optic. Cable TV, Broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. **PTL Test Equipment, Inc**. Phone 561-747-3647 FAX 561-575-4635. E-Mail: PTLTE@aol.com http://www.PTLTEST.com

AFFORDABLE HP power sensor repair! Most 8481As repaired for $255 or less. We also handle 478As and many others. Call or fax for more information. Willamette RF, Inc., 541-754-7226, FAX 541-753-4629.

FACTORY NEW, Firebird 2000 data error analyzer, complete with operating & remote control manuals, accessories covers etc., $250, 4 available. Hewlett Packard audio analyzer 8903A, $475; Tektronix 466 $250. 1142A probe control power module, $185, 4 available. Hitachi V422 o-scope, w/manual & probes, $250. Call for others. **Psitech Plus** 707-745-4804.

TEKTRONIX 7603, top shape w/7A26, 7A13 & 7B53A, $300. 323-662-8282.

Quality Used Test Equipment

90 DAY WARRANTY Parts & Labor - 10 DAY TRIAL PERIOD

HEWLETT PACKARD

105B, Quartz Oscillator, aging < 5 x 10^{-10} per day	$700
11570A, Accessory Kit (use for 8405A calibration)	$250
11720A, Pulse Modulator, 2-18 GHz, >80dB on/off ratio	$400
11975A, 2-8GHz Amplifer (use w/ 11970 series mixers)	$1750
214B, 10 MHz Pulse Generator, 200W Pulse/50 ohms	$700
2225A, ThinkJet Printer, HPIB	$125
2934A, Printer, HPIB	$200
3314A, Arbitrary/Function Generator	$1250
3325A-2, 21MHz Synth Func Gen, 40Vp-p, HPIB	$850
33322H, Prog Attnenuator, DC-18GHz, 0-110dB	$200
3403C, Digital RMS Voltmeter, 2 Hz-100 MHz	$150
3421A-201/44462A, Data Aquisition Control Unit, HPIB	$325
3455A, 6.5 digit Multimeter, HPIB, cal'd with cert	$300
3456A, 6.5 digit Multimeter, HPIB, cal'd with cert	$450
3468B, 5.5 digit Multimeter, HP-IL	$300
3478A, 5.5 digit Multimeter	$350
3488A, Switch/Control Unit	$350
3497A, Data Acquisition/Control Unit	$150
3498A, Data Acquisition Extender	$300
3852A, Data Acq/Control Unit	$800
436A-02-022, Power Meter w/ sensor cable, HPIB	$550
44462A/63A, 8 Chan MUX/2 Chan Actuator (3421A)	$135
5004A, Signature Analyzer	$200
5087A-033, Distribution Amp, 10MHz in/out, 12-chan	$1000
5180A, Waveform Recorder, 20MHz	$500
5314A, 100 MHz Counter	$150
5315B, 100 MHz Counter	$200
5316B, 100 MHz Counter, HPIB	$275
5328A-011-020-030, 512 MHz Counter w/DVM, HPIB	$225
5334A-060, 100 MHz Counter, front & rear input, HPIB	$300
5334B, 100 MHz Counter, HPIB	$400
5335A, 200 MHz Counter, HPIB	$575
5335A-10-40, 200 MHz Counter, Oven Oscillator, HPIB	$725
5345A, 500 MHz Counter, Oven Oscillator	$400
6034A, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB	$650
6034L, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB	$575
6110A (Harrison), Pwr Sup, 3KV @ 6mA	$150
6253A, Dual Pwr. Sup., 0-20V@3A	$275
6255A, Dual Pwr Sup, 0-40V@1.5A	$350
6267B, Pwr Sup, 0-40V @10A	$450
6268B, Pwr Sup, 0-40V@30A	$600
6271B, Pwr Sup, 0-60V@3A	$225
6284A, Pwr Sup, 0-20V@3A	$100
6289A, Pwr Sup, 0-40V@1.5A	$100
6294A, Pwr Sup, 0-60V@1A	$100
6515A, Pwr Sup, 0-1.6KV@5mA (cable kit incl)	$200
7550A, Graphics Plotter, HPIB	$200
7570A, Draft Pro Plotter, HPIB	$250
8012B, 50MHz Pulse Generator	$300
8111A, 20 MHz Pulse/Function Generator, 16Vp-p	$1250
8160A, 50MHz Programmable Pulse Generator, HPIB	$1600
8447A, RF Amp, 0.1-400MHz, 20dB gain, +6dBm out	$300
8481A, Power Sensor, .01-18GHz, -30 to +20dBm	$475
8494H, Prog Attenuator, DC-18GHz, 0-11 dB, SMA type	$375
8496H, Prog Attenuator, DC-18GHz, 0-110 dB, N type	$375
8501A, Storage Normalizer (use w/8505A)	$750
85041A, Transistor Test Fixture Kit	$500
8566A, Spectrum Analyzer, 100Hz-22GHz, HPIB	$11000
8568B, Spectrum Analyzer, 100Hz-1.5GHz, HPIB	$7500
8569B, Spectrun Analyzer, 0.01-22GHz, HPIB	$5000
8640B, Signal Generator, 0.5-512 MHz, AM/FM/Pulse	$700
8660C/86633B/86603A, 2.6GHz Synth Sig Gen	$1800
8662A, Synthesized Signal Generator, .01-1280 MHz	$14000
8672A opt 4 & 8, Synth Signal Generator, 2-18GHz	$4000
8903B-001, Audio Analyzer, 20 Hz-100 KHz, rear input	$1500
9411B, Switch Controller, HPIB	$450
9413A, VHF Multi-Port Switch	$450
E1407A, VXI A/B-C-Size Active Adapter	$200

TEKTRONIX

1730, NTSC Waveform Monitor	$900
7854, Keyboard Only	$125
7A24, 400MHz Dual Trace Amplifier	$175
AM503, Current Probe Amplifier	$250
P6136, 10X probe, 350 MHz, use w/2400 series o'scopes	$100
P6452, Data Aquision Probe (use w/ DAS9100)	$150
P6460, Data Aquisition Probe (for 1240/1241 Analyzer)	$150
PG502, 250 MHz Pulse Generator, use w/TM500 series	$300
PS503A, Triple Pwr Sup, 0 to +/-20V@1A, 5V@1A	$150
T922R, 15MHz O'Scope, Rear Input	$350
TDS460-1M, 350 MHz Digital O'Scope, 4-Channel, extra memory, includes 2 new P6138A probes & manuals	$4000
TDS540A-1F-1M, 500 MHz Digital O'Scope, 4-Channel, extra memory, 1.44 floppy, 4 new P6139A probes, manuals	$7800

MISCELLANEOUS

AstroMed ASC902, Medium Gain Amplifier Plug-in	$100
Clarostat 240C, Power Decade Resistor, 0-1,111,110 ohm	$150
EIP 545A-05-08, Microwave Counter, 10 Hz-18 GHz	$550
EMI TCR160T30, Pwr Sup, 0-160V@30A	$650
Fluke 5440B, DC Calibrator, 0-1100V, 3ppm accuracy	$2800
Fluke 6010A, Synthesized Func Gen, 10Hz-11MHz, GPIB	$225
Fluke 845AB, High Impedance Null Detector	$300
Fluke 8922A, Digital RMS Voltmeter, 2 Hz-11 MHz	$400
Heise 711B, Digital Pressure Gauge, 0 to 30 PSI, .05%	$350
Interface 553, Mil-Std-1553 Anaylzer	$850
Krohn-Hite 3550, Filter, Hi/Lo Pass, Band Pass & Reject	$275
PAR 128, Lock-in Amplifier, 0.5Hz-100KHz	$500
RF Power Labs M102L, RF Amp, 30Hz-100MHz, 2W	$450
Rockland 852, Dual Hi/Lo Pass Filter	$450
Sorensen DCR20-115B, Pwr Sup, 0-20V@115A	$475
Sorensen SRL40-12, Pwr Sup, 0-40V@12A	$350
Sorensen SRL40-25, Pwr Sup, 0-40V@25A	$475
Specral Dynamics SD131L, Tracking Filter	$600
Wavetek 178, 50MHz Programmable Waveform Synth	$900
Wavetek 2001, Sweep Generator, 1-1400MHz	$375
Wavetek 271-02, 12MHz Pulse/Func Gen, GPIB	$400
Wavetek 859, 50 MHz Prog Pulse Generator, GPIB	$575

Visit our website at www.testequipmentplus.com

TEST EQUIPMENT PLUS

(520) 575-6967, FAX (520) 575-6936

3331 W. Bright Terrace, Tucson, AZ 85741

Write in 71 on Reader Service Card.

TIMELESS PRODUCTS

The Best Prices and Service • In Business over 15 years!

Phone 218-346-6660 Fax 218-346-6664

CABLE TV CONVERTERS

WILL NOT DECODE

New! "TP 125 V"

128 Channel Converter with Volume

Special Prices for TP1550PC Call for Details

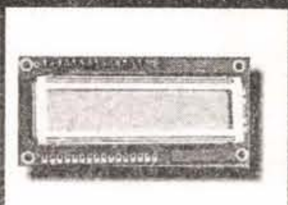
Panasonic still available!

- REFURBISHED CONVERTERS ALSO AVAILABLE •
- QUALITY REPAIR DEPARTMENT FOR ALL YOUR TUNER REPAIRS •
- REMOTES AVAILABLE FOR MOST CABLE BOXES •

DEALERS ONLY • GREAT QUANTITY PRICES • NO DECODER SALES

Write in 72 on Reader Service Card.

LOWEST COST LCD'S ON EARTH

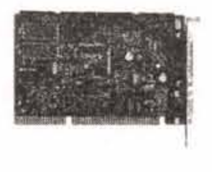




VIDEO LCD
4 Inch Video NTSC $150
Sharp P/N 4LU4E
Composite NTSC & RGB Input
12:00 OR 6:00 Viewing Angle
Integrated Backlight & Inverter
Extended Temp: -10 to + 60 C
Brightness: 260 nits
Power Consumption: 4.3 Watts
Contrast: 50 to 1

CHARACTER LCD
OPTREX DMF-5005SN-EW
240 x 64 Graphic EL Backlit STN $30
OPTREX DMF-5005N
240 x 64 Graphic Reflective STN $30
SANYO DM2023-7G1
2 x 20 Character Reflective STN $8
SHARP LM20A21
2 x 20 Character Reflective STN $8
VIKAY 2035TNLD NOTW-D
2 X 16 Character LED Backlit STN $8

LCD MONITOR
10.4" DSTN or 12.1" TFT
Analog SVGA Input
Autosync
Auto Sizeing
Automatic Expansion of VGA images to SVGA (On 12.1")
Very Aggressive Pricing Starting under $500!





TOUCH MONITOR
EarthVue 10.4
10.4" VGA TFT
Analog VGA Input
105 Nit Brightness
RS-232 Touch Screen Option
Only 9.9"W x 7.7"H x 1.5"D
Ideal For Factory Automation
Fully Articulating Ball Mount
Only $1095 With Touch

LCD DISPLAYS

6.3" Mono STN	$60
9.4" Mono Reflective	$60
8.4" TFT	$250
9.4" DSTN	$150
10.4" TFT	$350
10.4" DSTN	$240

NoteBook Screens
340 Models in Stock
Obsolete Screens Stocked
Hard To Find LCD? Call!

CONTROLLERS
ISA
PCI
PC/104
NTSC
Analog VGA
Complete LCD Kits with LCD, Controller & Cable Starting under $200

EARTH
Computer Technologies
"The World Leader In LCD Recycling"

Ph: (949) 361-2333 Fax: (949) 361-2121
http://www.flat-panel.com

Write in 73 on Reader Service Card.

REFILL INKS FOR INKJET PRINTERS

Refill your old cartridge and save. All refill kits come with instructions and needed materials for refilling inkjet cartridges. Success guaranteed. Available for the following:

CANON BC-01, BC-02 CANON BJ10e, APPLE STYLEWRITER, BJ-200 Single, Black, $8.00. **CANON BJC-600** (BC-201) Single Black or Single Colors (3 refills) $8.00. **CANON BJ-130/300/330 & IBM Exec Jet** (Cart #BJI-481 & BJI-642) Black - 3-bottle kit $22.00. **CANON BJC-210/240** (BC-05 Cart) 3-color kit (3 refills each color for BC-05) $24.00. **CANON BJC-4000** and Apple Stylewriter 2400 Black 3-bottle kit (3 refills BC-20, 9 refills BCI-21 black, 30 refills BCI-11 black, 10 refills BCI-10) $19.00. **CANON BJC-4000/BJC70** and **Apple Stylewriter 2400** Tri-color kit - 6 refills each color for BCI-21 or 15 refills each color for BCI-11 $24.00. **CANON BJC-800/820/880** 3-bottle kit (for BJI-643B) $19.00. **CANON BJC-800/820/880** 3-bottle tri-color kit (Cart #BJI-643CMY) $24.00. **EPSON STYLUS COLOR PRINTER** - (Cart S020034) Single Triple black $19.00; Tri-color kit (Cart S020036) 2 refills each color $24.00. **EPSON STYLUS COLOR II** - (S020047) Triple Black $19.00 (S020049). Tri-color (2 refills each color) $24.00. **EPSON STYLUS COLOR 400, 500, & 600** (S020093) Triple black (7 refills total) $19.00. **EPSON STYLUS COLOR 200, 500** (S020097) Tri-color 3 refills each color $24.00. **EPSON STYLUS COLOR 400, 600, 800, 1520** Tri-color (S020089) 3 refills each color $24.00. **EPSON STYLUS 800/1000** (S020025) 3-refill kit, black, $19.00. **EPSON STYLUS COLOR 440 AND 640** Black refill kit. (S020187) 4 refills plus free vacuum bottle $19.00. **EPSON STYLUS COLOR 440, 640, AND 740** (S020191) Color refill kit. 4 refills of each color $24.00. **HP DESKJET 500/550/560** (51608A, 51633A, 51626A) Black single refills $8.00. **HP DESKJET 500/550/560.** Black 3-bottle kit $19.00. **HP DESKJET 500C/550C/560C .** Tri-color kit (5 refills each color) $24.00. **HP DESKJET 1200C, DESIGNJET 650** (Cart #HP 51640B) Black Three pack (3 refills) $19.00. **HP DESKJET 1200C/1600C, DESIGNJET 650** (Cart #HP 51640 C,M,Y). Tri-color kit (one refill each color) $24.00. **HP DESKJET 600/660** (HP 51629A) Black three pack $19.00. **HP DESKJET 600C/660C.** (HP 51649A) Tri-color (5 refills each color) $24.00. **HP DESKJET 855C/1600C** (HP 51645A) Black three pack $19.00. **HP DESKJET 855C** (HP 51641A) Tri-color kit (2 refills each color) $24.00. **HP PAINTJET** and **PAINTJET XL** (51606A) Black 3-bottle kit $19.00. **HP PAINTJET** and **PAINTJET XL** (51606C) Tri-color kit $24.00. **HP PAINTJET XL300** (C1645A & C1656A) Black 3-refill kit $19.00. **HP PAINTJET XL300** Tri-color kit (1 refill each color) HP 51639C,M,Y $24.00. **HP THINKJET, QUIETJET, KODAK DICONIX 150** (51604A or 92261A) black 5 refills $9.00. **IBM/Lexmark/Execjet/4076** (1380620) black 3-refill kit $19.00. **IBM/Lexmark ExecJet IIC, WinWriter 150 C** (Cart #1380619) 4 refills each color $24.00. **Lexmark 3200, 5000, 5700, 7000, 7200, Optra 45 and Z51** (12A1970) 3 refills Black $19.00. **Lexmark 3200, 6000, 5700, 7000, Optra 45 and Z51** (12A1980) 4 refills each color $24.00. **SNAP AND FILL SYSTEM** - Permits refilling HP 51626A (black for HP 500-series) and HP 51629A (black for HP 600-series) cartridges without making a hole in the cartridge. Consists of special cartridge holder, syringe, plastic tubing, and directions. **STARTER KIT** - with ink for 3 refills $28.00. **EXTRA INK FOR SNAP & FILL SYSTEM** (black only) 4-oz. bottle $18.00; 8-oz. bottle $34.00. Specify whether for HP 51626A or HP 51629A.

HARD-TO-GET PRINTER RIBBONS

Gorilla Banana, Commodore 1525 **$8.00**; Adam Coleco **$12.00**; TI-850/855 **$6.00**; Centronics 700 Zip Pack **$5.00**; C. Itoh Prowriter Jr., Riteman C+/F+ **$6.00**; Riteman Inforunner **$8.00**; Commodore MPS-801 **$5.00**; MPS 803 **$5.00**; Decwriter LA30/36 **$4.00**; Apple Scribe **$4.00**; Mannisman Tally Spirit 80, Commodore 1526 **$5.00**; Epson JX-80 4-Color **$14.00**. Printronix P-1013 **$11.00**; Star SJ144 color 3-pack **$29.00**.
ALSO HEAT & TRANSFER RIBBONS AND PAPER FOR PRINTING T-SHIRTS.

Over 300 different ribbons in stock. All ribbons new, not re-inked. Fully guaranteed. Order directly or send SASE for complete list.

Add $4 per order shipping. CA residents add 7.75% sales tax. On ribbon orders over $50 deduct 10% dis-

H.T. ORR Computer Supplies
249 Juanita Way, Placentia, CA 92870-2216
714-528-9822 · 800-377-2023 · FAX 714-993-6216
http://www.extremeplay.com/occomp/orr.htm

Write in 74 on Reader Service Card.

FLUKE 540B: Thermal transfer standard 0.25 to 1000 VRMS min ± 0.01%, $350; Fluke, as new 1921A True RMS voltmeter, $150. 2280B data logger lots of options, $400. Psitech Plus 707-745-4804. Check our new www.psitech-plus.com

EQUIPMENT SALE: HP 83592B, opt 002 .01-20GHz sweeper and 8350B frame, $7,250; **HP 3325A opt 001, 002** $1,200; Hewlett Packard 3336C synthesizer & level generator with options 004, 005, $700, plain $300; Wavetek 3001 signal generator, $275; Hewlett Packard 8015A opt 03, $250, 8015A $200; HP 3403C opt 03 TRMS voltmeter $200, 3403C $150; HP 8115A dual channel pulse generator as new, $2,250. 3 month warranty. Psitech Plus 707-745-4804, check our new www.psitech-plus.com

BRUEL & KJAER BUY, SELL, BEST PRICES. EXCALIBUR ENGINEERING, 3198-C AIRPORT LOOP DRIVE, COSTA MESA, CA 92626. 714-540-0169, FAX 714-540-5417.

NEW, FASTER, POCKET TESTBENCH, tiny, inexpensive, portable RS-232 instrument, with scope, logic analyzer, counter, generator. Oricom Technologies, 303-449-6428. www.sni.net/~oricom

TEST EQUIP: GR1308/M $1,000; GR 1381/M $325; GR1382/M $325; GR1666/M $750. 6-7pm EST or/BO 978-251-3855.

TEKNET ELECTRONICS buys and sells electronic test equipment. For great prices on refurbished scopes, counters, generators, spectrum analyzers, telecom equipment and more, take a look at our inventory at www.instrumentrepair.com/teknet Most sales include operation manual and accessories, NIST traceable calibration, five day ROR, and 90 day warranty. Visa and MasterCard accepted. 770-449-3760, fax 770-449-3843. E-Mail: teknet@instrumentrepair.com

TEKTRONIX TDS540 500MHz 4 channel sampling oscilloscope, in perfect condition. Calibrated by Tektronix 03-Nov-1999. In sealed Tektronix shipping container. 90-day Tektronix warranty. Does not include probes or manual, $4,000 plus shipping.

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

SOLDERING DESOLDERING stations: **Pace** MBT250 $700, PPS85A $350, SP2 $75; Weller DS1000 $250, **hot tweezers** $50. Soldering stations: Weller: WTCP $50, digital readout: EC2000 $100, EC2002 $150u, $225nu, EC2001ESD $125. Solder: rosin $8, silver $4. 310-515-2058.

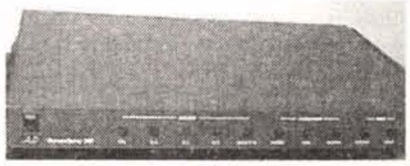
SECURITY

STOP THEM from listening in or recording your telephone conversations with the **TELEPRIVACY-PLUS**. Send $49 to Vakis, 1402 Pine Ave., Niagara Falls, NY 14301.

CONSUMERTRONICS 120+ exciting manuals: Electronics, computers, Internet, phones, energy, radionics, financial (including stocks), crime-fighting, security, survival, phenomena, **SPECIAL PROJECTS**. Catalog $3. PO Box 23097, Albuquerque, NM 87192. **www.tsc-global.com**

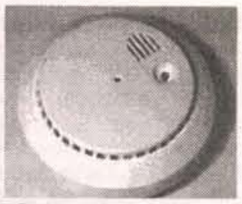
ALL NEW: THE COVERT CATALOG 2000. The MASTER LIST of information suppliers, specialized newsletters, OEM lock picks, reverse engineers, spy shops, alternate IDs, program crackers, and more. Locate impossible equipment, shop where the smart guys shop. Provides hundreds of addresses, sample pages, catalog prices and recommendations that will save you money on everything from break-in books to undetectable bugs. Catalog #COVCAT-2, price $34.95 + S&H $6 US, $7 CAN. NY state add $3.38 tax. Visa, MC, Discover, money orders. Mail: CRB, PO Box 56-NV, Commack, NY 11725. Phone: 516-543-9169.

SURVEILLANCE-COUNTERSURVEILLANCE: I buy and sell used equipment. Steve 410-879-4035.

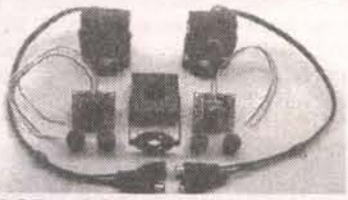


SECURITY CAMERA QUAD PROCESSOR: American Dynamic AD1476 real-time high-resolution B&W 2-page duo-quad. W/time + date generator, sequential switcher, titler, 2-video outs, full-screen playback. ADs top-of-the-line quad unit. A MUST for any home or business security camera sys. Industrial unit, not a toy. BNC ins + outs. This unit will take up to 8 cameras and display them in quad mode or full-screen. Dlr. cost **$575**. NOW **$225** w/1 yr. warranty, while supplies last. Also avail: AD1475A, **$175**; AD1474-4 cam quad, **$125**, and other multiplexers @ 40-60% off dlr. prices. Remember: Don't buy junk. Pro-Vid Systems, Woburn, MA. 781-933-0827. E-Mail: ricksvideo@msn.com

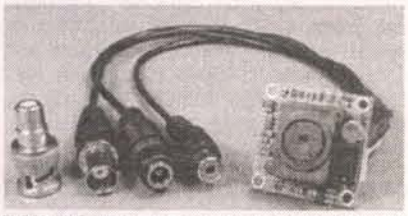
SPY FILES or Encyclopedia of Investigation CD-ROMs, each contains thousands of pages of fascinating and useful documents. With Adobe reader, $32 each postpaid. Info at www.davidvineassociates.com Credit card orders only call 1-800-987-8743.



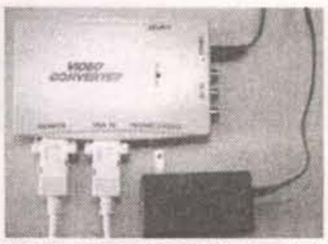
SALE! PS 102: Built-in pin hole CCD, lens size: 3.6mm. 5-1/2" (D) x 1.7" (H). **$79 @ 5 pcs.**, $72 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com



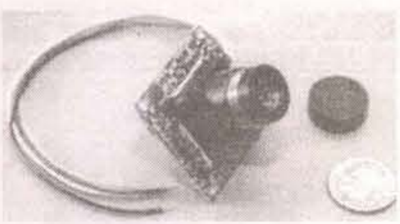
COLOR — LOW light CCD pin hole and standard lens available, only 1.27" x 1.27", $109. Sony sensor **with audio**. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com



B/W BOARD camera w/audio, $49 @ qty 10, 1.27" x 1.27". Enclosure available for $10. Matco, Inc., 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com



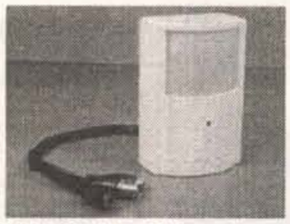
CONVERTS PC MONITOR to SECURITY MONITOR. The VGA-801 accepts standard NTSC or PAL inputs for display on any existing VGA/SVGA computer monitor. Small compact size, 4-1/2" x 2-1/2" x 3/4". Over 600 lines of resolution, twice that of standard TV monitor! High quality audio output feeds speakers directly. Excellent grey-scale conversion; works well with B/W inputs. Power supply included; **$69 each**. Dealers welcome. MATCO, Inc., 1-800-719-9605; Fax 847-619-0852; E-Mail: sales@mat-co.com Website: www.mat-co.com



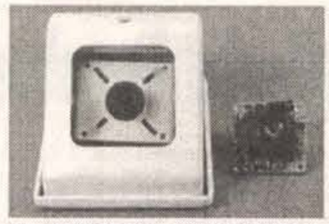
B/W 430 LINE CCD CAMERA with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type. 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; 9-14 VDC, 0.08 lux, IR sensitive; 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. Price @ 10 pcs., **$44 each**. Enclosure: $8; optional lens: $18. Dealers welcome. MATCO, Inc. 1-800-719-9605. Fax 847-619-0852. E-Mail: sales@mat-co.com Website: www.mat-co.com

SEEKING DISTRIBUTORS FOR SECURITY PRODUCTS. Matco, Inc., Schaumburg, IL 630-350-0299. www.mat-co.com

AS-1004, FCC approved. 2.4GHz transmitter & receiver with audio! Capable handling total of 4 wireless cameras, range: >300'. Built-in camera, 400 TV line. **$189 a pair** @ 5 pcs., $179 @ 10 pcs. Additional camera $119 @ 10 pcs. Matco, Inc. 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com



SPECIAL! IC 113: PIR motion detector with audio! W/ NO/NC alarm output. CCD camera with audio can be turned on by detector. 5-1/4" (L) x 2-3/4" (W) x 2" (D). **$89** @ 5 pcs., $82 @ 10 pcs. Matco, Inc. 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com

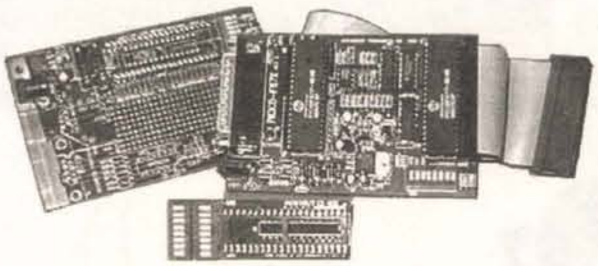


WEATHERPROOF ENCLOSURE for board cameras, fits all 30-42mm color/back & white cameras, $59. Matco, Inc., Schaumburg, IL 1-800-719-9605 Fax: 630-350-9546. E-Mail: nsales@mat-co.com Web site www.mat-co.com

Happy New Year!

PIC Real-time 'Emulator' and Programmer for $159

Introducing PIC-ICD = Debugger + Programmer + Demo Board = $159



- For PIC16F87X and emulates most PIC16C6X/7X
- In-circuit run-time debugging
- Real-time code execution
- High speed parallel port interface
- Built-in device programmer
- 2.5V to 6.0V operating range
- One level real-time breakpoint
- Two external break inputs
- Conditional animation break
- Run, step, run to Cursor, etc.
- Operating frequencies from 32khz to 20mhz
- Runs under PICICD IDE (Win 95/98/NT) or MPLAB™ (Win 95/98)
- Source level and symbolic debugging
- Software animation trace captures 3 user-defined variables in addition to opcode, W, STATUS, FSR registers and corresponding instructions
- Comes with ICD Debug module, demo board, 40-pin and 28-pin emulator headers, cable, power adapter, IDE software and printed user's guide

Hear this ...

"Impressed with both the technical performance of the emulator and the cooperative attitude of the company personal. I will recommend your products to others" - DJ Caldwell, CA

"Great product with excellent support!" - K M Bowers, NC

"Unprecedented customer service" - R Thomas, NC

New Low Prices Best Value

RICE17A Emulator System now from $599 to $700

- 64K program memory
- 32K real-time trace
- 12-clip external probe - break input, break output, trigger output, 8 logic traces and ground
- Source level debugging
- Unlimited software breakpoints and trigger points
- New PB-877 and PB-77X probew provide data breakpoint (Jan 2000)
- Supports PIC12/16/17
- Low voltage emulation
- Self-diagnostic test board

Single Socket PIC Programmers and Adapters

- PGM16N supports all PIC12/14/16
- PGM17 supports all PIC17
- One 40-pin ZIF socket for all DIP parts
- Optional surface mount sockets for all package types which are compatible with all PIC programmers
- Emulation headers in SOIC, PLCC and QFP packages
- Win 95/98/NT hosting software
- DOS software for PGM17
- Compact and portable

Stand Alone Gang Programmer from $900

- New flash based firmware makes new device support a snap
- Production quality 8-gang programmer for PIC, SX, ST6 and more
- Approved by IC manufacturers
- Stand-alone chip duplication
- LCD and LEDs display program functions and results
- Codes reside securely in EEPROM of control module
- Custom all programming voltages in 0.1v increments

Advanced TransdAtA
CORPORATION
14330 Midway, #128, Dallas, Texas
Tel 972.980.2667 Fax 972.980.2937
Email: atc1@ix.netcom.com

Visit the Ultimate Source for PIC Tools at

www.adv-transdata.com

Write in 75 on Reader Service Card.

World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!

Examples Include:

- **Measuring Temperature**
- **Using a Photocell to Detect Light Levels**
- **Making a Waveform Generator**
- **Constructing a Capacitance Meter**
- **Motor Speed Control Using Back EMF**
- **Interfacing and Controlling Stepper Motors**
- **Scanning Keypads and Writing to LCD/LED Displays**
- **Bus Interfacing an 8255 PPI**
- **Using the Primer as an EPROM Programmer**
- **DTMF Autodialer & Remote Controller (New!)**

The PRIMER is only $119.95 in kit form. The PRIMER Assembled & Tested is $169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade ($49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add $5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad ($29.95) installed. Satisfaction guaranteed.

EMAC, inc.
11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: http://www.emacinc.com

1985 - 1998
OVER 12 YEARS OF SERVICE

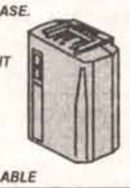
Write in 76 on Reader Service Card.

PRIMECELL

IF YOU NEED NEW BATTERIES FOR YOUR ELECTRONIC EQUIPMENT DON'T PITCH EM' - SEND THEM FOR REBUILDING ! - SAVE $ $

CUNARD ASSOC. INC., 9343 US RT 220, Bedford, PA 15522

- *WE INSTALL NEW NI-CAD OR NI-MH BATTERIES INTO YOUR ORIGINAL CASE.*
- *WE IMPROVE CAPACITY TO BETTER THAN ORIGINAL.*
- *WE FIX WHAT CAN'T BE FOUND. (OR AFFORDED)*
- *WE PROVIDE QUICK SERVICE. / EXTENDED LIFE FOR OLDER EQUIPMENT*
- *WE OFFER FREE QUOTES. / FREE RETURN IF QUOTE IS REFUSED.*
- *WE PROPERLY DISPOSE OF YOUR OLD CELLS BY RECYCLING.*
- *WE GIVE YOU A 12 MONTH WARRANTY.*
- *WE WILL BE HERE WHEN YOU NEED US / EST. 1986*
- *WE SAVE YOU **** M O N E Y **** $ $ $ $*



- *NO JOB IS TOO LARGE OR TOO SMALL .... VOLUME DISCOUNTS AVAILABLE*

GENERAL ELECTRIC
19A704850P(1200mAH) $ 34.95
19A704860P(1800mAH) $ 39.95
PL19D429763(777)G1/3 $ 37.95
19A705293P 344A4506P $ 34.95

M AXON SA-1155 1160 $ 39.95
TAD 1450 1510 1520 $ 21.95

M O T O R O L A
P200 HT600 MT1000
NTN 4585 4824 5414 $ 37.95
NTN 5447 5521 5545 $ 37.95
NLN 5860 NTN 4327 $ 39.95

M I D L A N D
70-B10 B16 B19 B21 $ 39.95
B25 B26 B32 B36 B60 $ 39.95

U N I D E N
APX650 1050 $ 29.95
1000 1010 1070 $ 34.95
1100 1200 Series $ 36.95
BP205 650mAh $ 19.95
BP200 1500mAh $ 24.95
SC150 1500mAh $ 22.95

I C O M
BP2 / BP3 /BP22 $ 18.95
BP5 / BP23 / 24 $ 24.95
BP7 / CM7/ BP8 $ 32.95
BP180 / CM79 $ 34.95

Y A E S U
FNB 3 4 12 14 16 $ 32.95
FNB19 21 26 27 38 $ 32.95
FNB 10 1117 25 35 $ 23.95

RADIO SHACK
HTX Packs $ 29.95
New 8.4V pack & chgr
1500mAh nimh $ 34.95

K E N W O O D
PB2 / KNB3 $ 29.95
PB21/21H $ 14.95
PB25/H/26 $ 24.95

CORDLESS DRILLS
Any brand 7.2V $ 18.95
Any brand 9.6V $ 29.95
Any brand 12.0V $ 32.95
Any brand 14.4V $ 37.95
Any Brand 18.0V $ 45.95

COMPUTER PACKS
Send battery for quote.

FOR INFORMATION ABOUT YOUR REQUIREMENTS ...... CONTACT US:
PHONE OR FAX : (814) 623-7000 E-MAIL TO: PRIMECELL @ AOL.COM
SEND YOUR PACKS FOR FREE QUOTATION VIA UPS, RPS OR US MAIL
VISIT OUR WEB SITE http://members.aol.com/primecell/primecell.htm

BATTERY REBUILD SERVICE

MasterCard — MANY OTHERS AVAILABLE - WRITE OR CALL — VISA
F R E E C A T A L O G
ADD $ 4.50 SHIPPING & HANDLING PER ORDER

Write in 77 on Reader Service Card.

HIDDEN VIDEO SURVEILLANCE CAMERAS. Factory direct, quality products & low prices. We design and manufacture our products. Free catalog, fax request to: MJ Electronics, phone/fax 914-699-2294. Call anytime.

SATELLITE EQUIPMENT

FREE FLYER on DBS files, hacking, hardware info. Smart card socket $5 ea. New Atmel 89C52 $10 ea. Bill 1-800-879-9657.

BEST PRICING on 18" satellite TV systems for home and RV. DISH Network DirecTV, multi-room viewing options, accessories, more. www.skyvision.com **Call 1-800-543-3025.**

FREE SATELLITE TV SYSTEM! Now is the time to get a small dish. Call 626-568-0903 and give certificate number 0141002. www.iwantadish.com

FREE BIG dish catalog. Low prices! Systems, upgrades, parts, and "4DTV." Skyvision, 1010 Frontier Dr., Fergus Falls, MN 56537. www.skyvision.com **Call 1-800-543-3025.**

Subscribe to Nuts & Volts Today!
Call 1-800-783-4624
and Use Your Visa or MasterCard.

ACP's 95th GIANT COMPUTER SWAP★MEET

Be a Seller ...for your space Call Mary

All Day Sunday 8am-2pm
Jan 30th
FREE Admission & Parking
Shop 100's of Sellers

in ACP's Giant Parking Lot !!!

Advanced Computer Products, Inc.
ACP SUPER★STORE
Since 1976

1310 E. Edinger
Santa Ana, CA
714-558-8813

CABLE TV CONVERTERS

★ ★ ★ ★ ★

Raven-85 plain converter: 85 channel, Ch-3 output, PG Lock, HRC/STD and sleep timer

Raven-99 plain converter: 99 channel, Ch-3 output, PG lock, MFT/Fine tuning, HRC/STD and sleep timer

Raven-135 converter: Volume control, 135 channel, Ch-3/4 output, PG lock, HRC/STD and sleep timer, audio & video output through RCA jacks

Raven-125 converter: Volume control, 125 channel, Ch-3/4 output, PG lock, HRC/STD(by remote unit) and sleep timer, audio & video output thru RCA jacks

FREE BROCHURES & PRICE LIST
CALL (310) 515-5085 or
FAX 1-800-579-5000
PCW Company

CABLE TV. Join us on the **INTERNET** to buy and sell cable TV equipment, electronic equipment, DSS equipment, satellite equipment, telephony equipment, and much more. Major equipment dealers and wholesalers online. Auctions, classified ads, discussion forums, chat rooms, and dealer links for all types of equipment. Dealers and vendors call or visit our site for ad rates and links. **WWW.GOCABLETV.COM** or call **1-800-451-0083.**

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

MILITARY SURPLUS ELECTRONICS

POLICE RADAR JAMMER only $50 + $3.20 S&H with this ad. Phantom brand, Jams X/K/Ka. Order form online. Electronic weapons, EMP, Herf, high voltage, rail/coil/disc guns, plasma, alternative energy, surveillance, etc. Plans and Kits Unlimited, 1839-D West Vista Way #515, Vista, CA 92083. Visit us at: http://www.plans-kits.com or E-Mail: nin teach@plans-kits.com

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

AUDIO – VIDEO – LASERS

ANTIQUE VIDEO TRANSFER SERVICE: transfer any 2" QUADRUPLEX tape. Affordable fast! Phone/fax 415-821-7500 or 415-821-3359. 5001 Diamond Heights Blvd., San Francisco, CA 94131-1621.

FREE LASER CATALOG. Helium-Neon, Argon, ruby, visible laser diode modules, lightshows, holography, laser pointers. Lowest prices. Midwest Laser Products, PO Box 262, Frankfort, IL 60423. 815-464-0085 **www.midwest-laser.com**

CONVERTS PC MONITOR to SECURITY MONITOR. The VGA-801 accepts standard NTSC or PAL inputs for display on any existing VGA/SVGA computer monitor. Small compact size, 4-1/2" x 2-1/2" x 3/4". Over 600 lines of resolution, twice that of standard TV monitor! High quality audio output feeds speakers directly. Excellent grey-scale conversion; works well with B/W inputs. Power supply included; **$69 each.** Dealers welcome. MATCO, Inc., 1-800-719-9605; Fax 847-619-0852; E-Mail: sales@mat-co.com Website: www.mat-co.com

Continued on page 59

by Fred Blechman

For the hopeless romantic, flowers, candy, and candlelight dinners don't last. Now you can build – from a $12.95 Velleman kit, or from scratch – a simulated "throbbing heart" that can be a constant reminder of your affection.

Not limited to Valentine's Day, but appropriate for birthdays, anniversaries, or just to express your enduring love, 28 bright red LEDs form two heart shapes – one inside the other – that blink alternately, like a beating heart. It is powered by a common nine-volt battery, or an external DC supply.

Velleman – a 25-year-old Belgian company – has come on strong in the United States recently in advertising its large line of electronic kits. The current 32-page, full-color Velleman catalog, describes and pictures 167 items, mostly kits, but some assembled. They range from simple kits, selling for as little as $5.95, to very professional and elaborate specialized kits and assembled equipment selling for hundreds of dollars.

Recently added was a line of mini-kits. These are small, easy, and simple to build, and are specially designed for those making their first steps into the fascinating world of electronics.

We decided to purchase the MK101 "Flashing LED Sweetheart" just to check the nature and quality of a Velleman mini-kit. Although the complete information is provided here for you to build the unit from scratch, we are going to assume you are building the kit, and will add considerably to the brief information included with the kit.

"Brief" Information?

The MK101 – apparently typical of the mini-kit line – comes packaged for rack selling, and all the information for building the kit is provided on a single, well-illustrated card with very little text.

A schematic is provided, using some International notation, which we'll get to further on. No printed circuit layout, which would be handy for troubleshooting, is provided. No parts layout is provided, since the nicely-made etched and drilled printed circuit board is clearly silkscreened with all part locations. No explanation of circuit operation is provided.

This is not to say that any of these things "not provided" are actually necessary. Built carefully following the excellent illustrations (reproduced throughout this article with permission), the kit will work fine. Like a car, you do not have to understand how the internal combustion engine works to drive.

However, since we strive here with our simple construction articles, to address the needs of those new to electronics, we will go into the details of building, troubleshooting, and operating this Velleman mini-kit.

The Schematic

Figure 1 shows the circuit diagram for the Flashing LED Sweetheart. Readers accustomed to schematics using symbols and notation common in the United States will notice some obvious differences in this schematic. Velleman kits apparently use some "International" symbols and notation.

This was all explained in detail by Ray Marston in his excellent article, "Electronic Circuit Symbols and Notations" in the Dec. '98 issue of *Nuts & Volts*.

Referring to Figure 1, first look

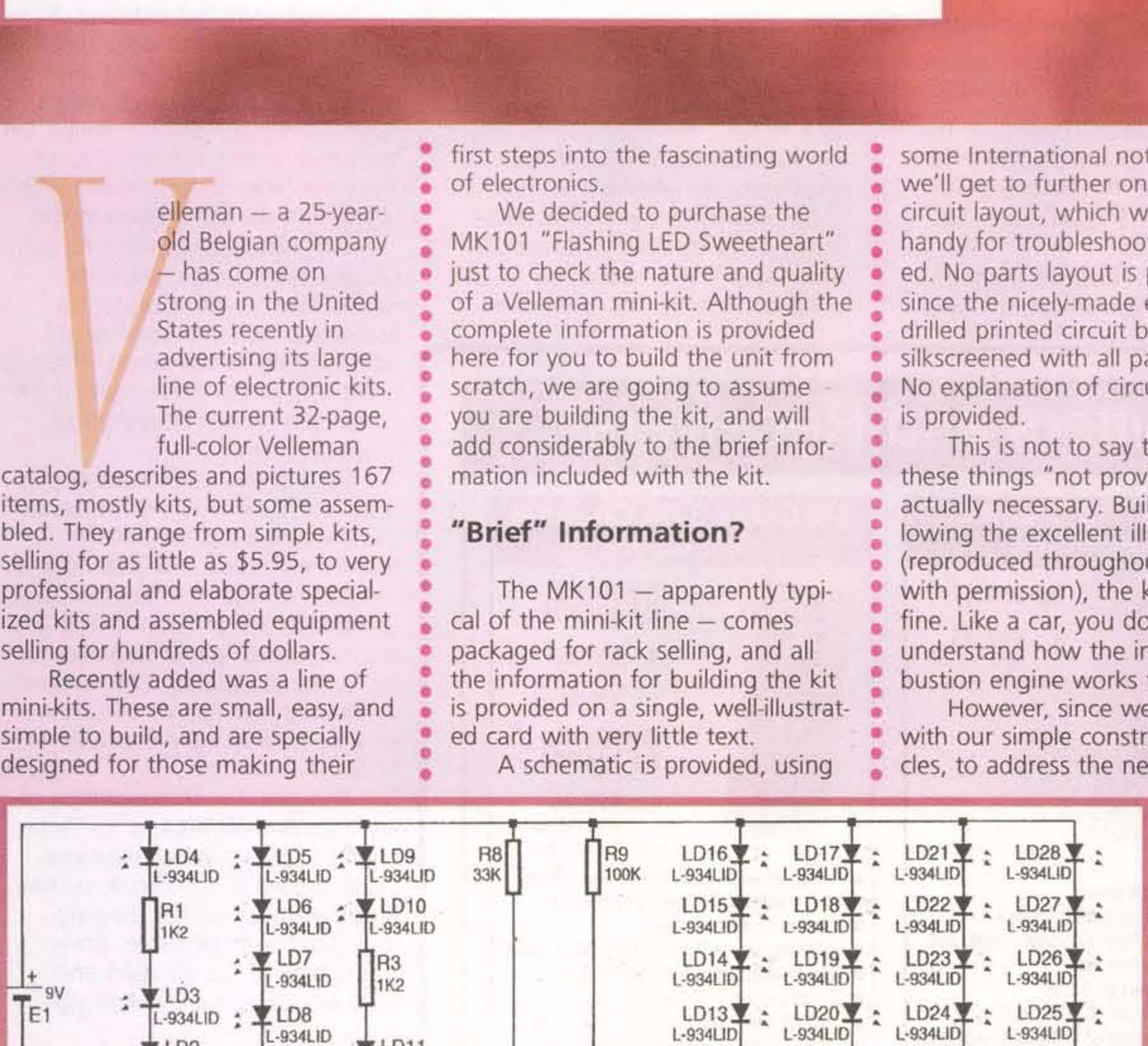


Figure 1: Schematic of Flashing LED Sweetheart. See text for explanation of some of the symbols and notation.

Holiday Project ♥

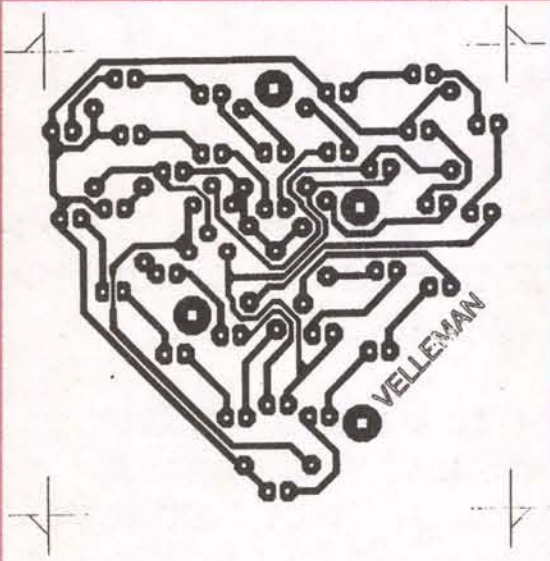


Figure 2: Printed circuit board layout (actual size).

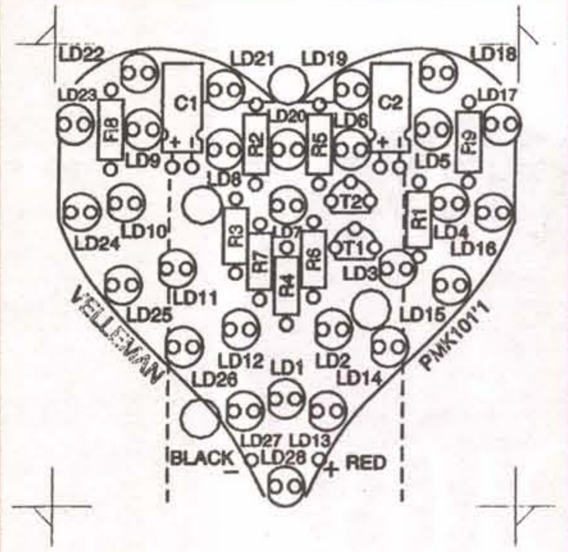
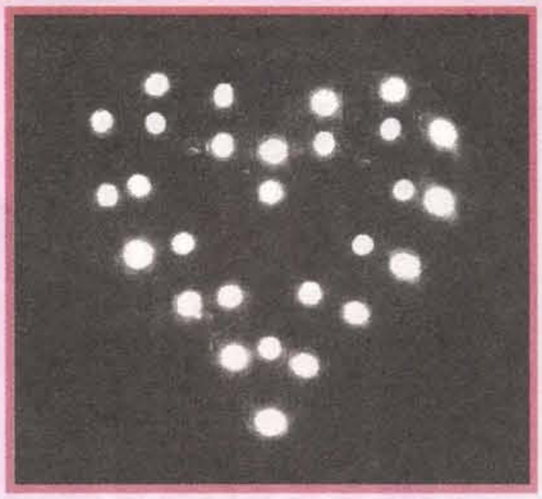


Figure 3: Parts layout (actual size).



In this time exposure, all 28 LEDs appear to be lighted. Actually, the "inner heart shape" and "outer heart shape" are lighted alternately.

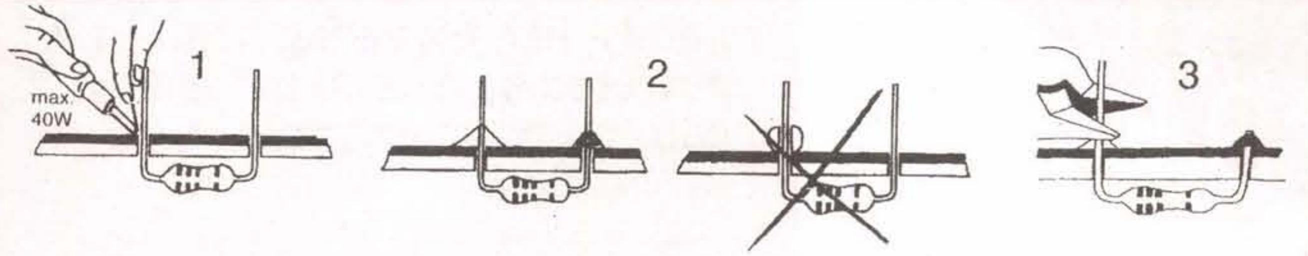


Figure 4: Proper soldering technique. See text.

at the symbols. A resistor is represented by a small rectangle instead of a zig-zag. The adjoining black and white rectangles with a plus sign is an electrolytic capacitor. The light-emitting diode (LED) and NPN transistor symbols are what we commonly use in the "US Customary" system.

Some notations look odd. The transistors are designated with "T" instead of "Q." The battery is "E" instead of "B." The LEDs are "LD" instead of "L."

The values for some components are another source of confusion. For example, where we would have "22uF," the International system (at least the one used here, since there are several!) just has "22u." Resistor value notation can be the most confusing, where the designation "1K2" would be "1.2K" in the US system. This is done to prevent possible drop-out of the decimal point in printing. Since there is no decimal point in "33K" and "100K," their notation is the same as the US notation.

Circuit Description

Now that you understand the symbols and notation, let's describe how this circuit works.

Notice that you have seven strings of four LEDS, each with a current-limiting resistor in series. On the circuit board, LD1-LD12 form the inner heart shape, while LD13-LD28 form the outer heart shape.

The schematic position of each resistor in its string represents where that resistor is physically assembled on the printed circuit board within its LED string. This is a great help in troubleshooting if the completed project doesn't work properly.

Each of the seven strings, plus resistors R8 and R9, are connected directly to the positive voltage. The termination of each LED string is at the positive side of either electrolytic capacitor C1 or C2, and also at the collector of either transistor T1 or T2. Resistors R8 and R9 connect to the negative side of C1 or C2, and the base of NPN transistor T1 or T2.

This circuit is an adaptation of an "astable multivibrator" or "relaxation oscillator." When nine volts DC is applied to the circuit, current (not electrons; current, flowing from positive to negative) flows through all of the 28 LEDS and their associated current-limiting

NOTE: Thanks to Michael Van Hee, Vice President of Velleman, Inc., for his permission to use the illustrations in this article. Most illustrations are in the kit instructions, but some he provided as a special courtesy.

Miniature Transmitters and Receivers

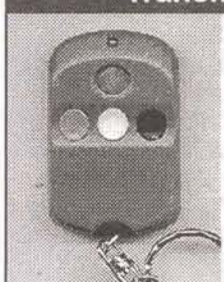
2 Button / 3 Channel Transmitter

RF300T
1....$22.95
5.....$19.95 ea
10...$16.95 ea

RF300XT
1....$25.95
5.....$22.95 ea
10...$19.95 ea

- 300' (XT), 150' (T) Range
- Frequency: 318 MHz
- 59,049 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.8 ma
- Fully Assembled in Case
- Dimensions: 1.25" x 2.0" x .5"
- Push both buttons for the 3rd Channel
- Slide Button Cover Included

4 Button / 15 Channel Transmitter



RF304XT
1....$27.95
5.....$24.95 ea
10...$21.95 ea

- 250' Range
- Frequency: 318 MHz
- 6,561 Settable Security Codes
- 12 Volt Battery and Keychain Included
- Current Draw: 4.6 ma
- Fully Assembled in Case
- Dimensions: 1.35" x 2.25" x .5"
- Push combination of buttons to achieve up to 15 channels

2-4 Data / 3-15 Channel Receivers

RF300RL
RF300RM
1....$27.95
5.....$24.95 ea
10...$22.95 ea

RF304RL
RF304RM
1....$29.95
5.....$26.95 ea
10...$23.95 ea

- Compatible with 300/4 Transmitters
- 11-24 volts DC Operating Voltage
- 13 ma. Current Draw
- Latching (L) or Momentary (M) Output
- Kits Available (subtract $5.00 ea.)
- Dimensions: 1.25" x 3.75" x .5"
- 2 (300) / 4 (304) Output Data Lines
- Binary to Dec / Hex Converter can achieve up to 15 channels

- Alarm Systems
- Garage / Gate Openers
- Lighting Control
- Magic Props
- Medical Alert
- Monitoring Systems
- Industrial Controls
- Surveillance Control
- Motor Control
- Schematics Available
- Receiver Board Layout Available
- Custom Design Consulting Available

Visitect Inc. (510) 651-1425 Fax: (510) 651-8454 Email: Support@Visitect.Com
P.O. Box 14156, Fremont, CA 94539 Visa / Mastercard, COD

Write in 160 on Reader Service Card.

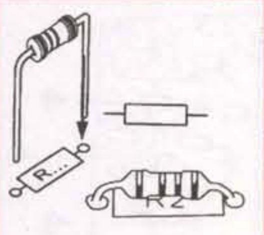


Figure 5: Resistor symbol and mounting.

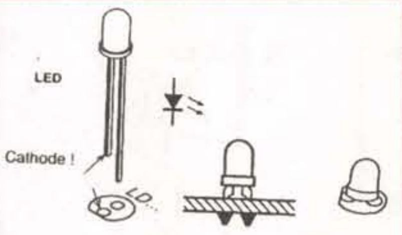


Figure 6: LED symbol and proper orientation. The flat on the base is the cathode side.

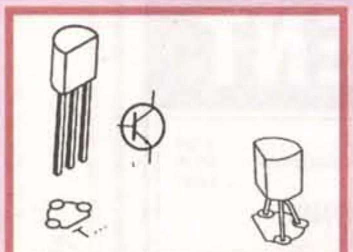


Figure 7: NPN transistor symbol, and orientation using the BC547B transistor supplied with the kit. If you use the 2N3904, reverse the position of the flat side. See text.

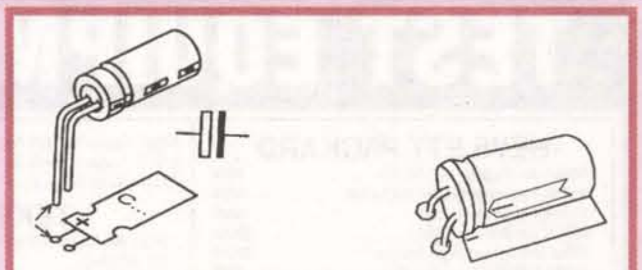


Figure 8: Electrolytic capacitor symbol and orientation.

resistors, looking for a return to the negative side of the battery.

At this point, NPN transistors T1 and T2 are cut off, since they need positive voltage on their base to conduct. As electrolytic capacitors C1 and C2 start to charge, they place a negative voltage on the bases of T1 and T2.

Resistors R8 and R9 are connected to the bases of NPN transistors T2 and T1, respectively, but R8 and R9 have greatly different values. First R8, with its lower resistance, applies positive bias voltage to the base of T2, turning it on and allowing it to conduct current between its collector and emitter and back to the negative side of the battery — just what the outer heart (LD13-LD28) is looking for, so it lights up. But not for long.

As C1 charges (since T1 is not yet conducting), its negative side cuts off T2, which needs sufficient positive voltage on its base to conduct. Now the positive voltage coming through R9 causes T1 to conduct and the inner heart (LD1-LD12) lights, and C1 discharges. But, with T2 now cut off, C2 starts to charge and causes T1 to get cut off. Now C1 charges, and the whole sequence keeps repeating.

Confused? It is tricky. The "speed" of lighting the alternating inner and outer heart shapes is based on the values of C1, C2, R8, and R9. To experiment with the finished project, change the values of any of these parts (easily done by putting a resistor or capacitor in parallel with an existing one) and watch the effect.

Finding the Parts

The Velleman MK101 kit provides all the necessary parts for this kit, including mini-LEDs, a 2.38-inch square silkscreened etched and drilled printed circuit board, and a battery holder. If you decide to build this from scratch, perhaps as a school project, you may have difficulty finding some of the part numbers in the Parts List at the end of this article.

All resistors and capacitors are commonly available. The LEDs are 1/8-inch diameter (3mm) high efficiency red, like Mouser 512-HLMP1340 for 18 cents each.

Common 2N3904 NPN silicon transistors can be used to replace the BC547B transistors — but with an *important* difference. The basing of the BC547B is CBE (collector, base, emitter) left to right looking at the front flat face. The 2N3904 is EBC. Since the center lead in both cases is the base, this just means inserting the 2N3904 transistor facing in the *opposite* direction from that shown for the BC547B.

The nine-volt battery holder is a Mouser 12BH610, and sells for 99 cents.

Construction

If you are going to build the kit from scratch, Figure 2 shows the printed circuit layout, and Figure 3 shows the parts layout. While there is nothing critical about parts placement (except the layout of the heart shapes), using a perforated board and point-to-point wiring would be asking for trouble. Either build this from the kit, or make a printed circuit board.

Although this is not a difficult construction project, there are some pitfalls. There are 86 solder points, and all 28 LEDs, the two capacitors, and the two transistors are "polarity sensitive" — they must be installed with the proper orientation. The illustrations will show this.

Since bad solder joints are a likely cause of improper operation, we must quickly cover the subject of soldering. Use a small — 40 watts or less — soldering iron with a small tip, and small-diameter (.020- or .031-inch) rosin core solder. Figure 4-1 shows that the tip of the iron and the solder should be placed together at the intended joint. Figure 4-2 shows proper solder joints covering the lead and with a smooth pyramid shape, and a balled-up unacceptable solder joint. Figure 4-3 illustrates cutting off the extra lead after soldering. This can be done easily with a nail clipper.

To begin assembly, insert all the resistors as shown in Figures 3 and 5. Resistors R1-R7 are color-coded brown, red, red. R8 has three orange bands. R9 is brown, black, yellow.

Next, insert all 28 LEDs (Figure 6), making sure the cathode side (usually a flat spot on the circular

The nine-volt battery holder mounts to the printed circuit side of the board.

BOB SAVED THE WORLD TODAY...

Bob, Super-Tech extrodinaire, has a secret weapon. This amazing device allowed him to locate and replace all 34 bad electrolytic capacitors in this TV in less than 30 minutes. So instead of throwing this TV into the local landfill and adding more pollution, Bob's secret weapon enabled him to give the World a brighter future. Impressed his manager and his customer too. Bob's secret weapon? The world's best in-circuit cap checker, the ***CapAnalyzer 88A*** by **EDS**.

Smart techs know that to be productive you need to find defective components quickly and accurately. That's why General Motors, Matsushita Industrial, Sears Service, Pioneer Electronics, Panasonic Authorized Service, NASA/Kennedy Space Center, Time/Warner Communications, NBC TV and thousands more independent service technicians have chosen the ***CapAnalyzer 88A*** over all of the other capacitor checkers. Check www.eds-inc.com/88users.html for actual ***CapAnalyzer*** users' comments as they compare their ***CapAnalyzer*** to the "wizards" and "z-meters" they already own. They all prefer the ***CapAnalyzer*** because it checks electrolytic capacitors, ***in-circuit***, with 100% accuracy. No unsoldering to check out-of-circuit, no mistaking a shorted or leaky cap as good, as other "ESR" meters do, no guessing about whether a value is good or bad. With our exclusive three-color comparison chart right on the front panel, auto-discharge, multi-beep alert, and one-handed tweezer test probe, even your pet monkey could find defective caps in that problem PWM power supply, TV, monitor or VCR in a few seconds.

...NOW IT'S YOUR TURN.

So get your own ***CapAnalyzer 88A***. It's only $179. With our exclusive 60-day satisfaction-or-money-back guarantee, you risk nothing. Prepare to be amazed: your only problem will be running out of work as you take care of all of those "dogs" that you've been sitting on. We're **Electronic Design Specialists**. We make test equipment designed to make you money. Available at your distributor now, or call 561-487-6103. Check out www.eds-inc.com for the details.

Write in 161 on Reader Service Card.

SURPLUS TEST EQUIPMENT

HEWLETT PACKARD

11664A, RF Detector, .01-18GHz ... $250
11666A, Reference Bridge, 0.4-18GHz ... $800
11721A, Frequency Doubler ... $600
11975A, Amplifier, 2-8GHz ... $2000
1650B, 80 Channel Logic Analyzer ... $2000
16500A, Logic Analyzer Mainframe ... $750
214B, 10MHz Pulse Generator ... $1000
3312A, Function Generator, .1Hz-13MHz ... $700
3325A, Synthesizer/Function Generator ... $1000
3325A/01/02, Synthesizer/Function Generator ... $1500
3335A, Frequency Synthesizer, 200Hz-81MHz w/Opt. 01 ... $4000
3456A, Digital Multimeter, 6.5 Digits ... $800
3468A, 5.5 Digit Multimeter ... $300
3468B, 3.5 to 5.5 Digit Multimeter ... $375
3478A, Digital Multimeter ... $700
3488A, Switch Control ... $400
3551A, Transmission Test Set ... $600
3562A, Dynamic Signal Analyzer ... $5000
35677A, S-Parameter Test Set ... $1500
3575A, Phase Gain Meter 1Hz-13MHz ... $1000
3577A, Network Analyzer, 5Hz-200MHz ... $6000
3581C, Selective Voltmeter ... $800
3582A, Spectrum Analyzer, 0.02Hz-25.5KHz ... $1600
3585A, Spectrum Analyzer, 20Hz-40.1MHz ... $4750
3852A, Data Acquisition/Control Unit ... $1000
4342A, Q-Meter ... $1800
435B, Power Meter ... $300
436A, Power Meter w/Opt. 022 ... $700
438A, Power Meter ... $2750
4935A, Transmission Impairment Test Set w/Opt. 003 ... $1100
5316B, Universal Counter ... $800
5328B, Universal Counter ... $1000
5340A, Frequency Counter w/Opt. 01/02/011 ... $1000
5342A, Microwave Frequency Counter, 10Hz-18GHz ... $900
54100A, Digitizing Oscilloscope ... $1700
54100D, 1GHz Digital Oscilloscope ... $2700
54110D, 1GHz Color Digitizing Oscilloscope ... $2500
54201D, Digitizing Oscilloscope ... $2650
6011A, Autoranging Power Supply, 20V/120A, 1000 Watt ... $1200
6012B, DC Power Supply, 0-60V/0-50A/1000 Watt ... $2250
6034A, DC Power Supply, 0-60V/0-10A, 200 Watt ... $1000
6274B, DC Power Supply, 0-60V, 0-15A ... $1250
6475C, DC Power Supply, 0-110V, 0-100A ... $3500
6632A, DC Power Supply, 0-20V, 0-5A, 100 Watt ... $1000
7035B, X-Y Recorder ... $250
778D, Dual Directional Coupler ... $400
8013B, Pulse Generator ... $500
8082A, Dual Pulse Generator, 250MHz ... $1200
8112A, 50MHz Pulse Generator ... $3300
8116A, 50MHz Programmable Pulse/Function Generator ... $3000
8165A/002, Programmable Signal Source w/AM ... $1500
8341A, Synthesized Sweeper, 0.01-20GHz w/Opt. 02 ... $13,000
8341B, Synthesized Sweeper, 0.01-20GHz ... $14,500
8347A, RF Amplifier, 100KHz-3GHz ... $2500
8349B, Microwave Amplifier, 2-20GHz ... $4000
8350A, Sweep Oscillator Mainframe ... $1000
8350B, Sweep Oscillator Mainframe ... $1250
83522A, Sweeper Plug-in, .01-2.4GHz, w/Opt. 02 ... $3500
83525A, RF Plug-in, .01-8.4GHz, w/Opt. 02 & 04 ... $5000
83545A, Oscillator Plug-in, 5.9-12.4GHz ... $1750
8495H, Programmable Attenuator (unused) ... $600
8501A, Storage Normalizer ... $1000
85021B, Directional Bridge ... $1200
8510B, Network Analyzer w/Opt. 010 ... $13,000
8511A, Harmonic Frequency Converter, 45MHz-26.5GHz ... $5500
8554B, RF Spectrum Analyzer Plug-in, 500KHz-1250MHz ... $800
8569A, Spectrum Analyzer, .01-22GHz ... $4500
86222B, Sweep Oscillator Plug-in, .01-2.4GHz w/Opt. 04, Rear Output and 8620C Mainframe ... $1250
86290A, RF Plug-In, 2.0-18GHz ... $1150
86290C, RF Plug-In, 2.0-18.6GHz ... $1550
8640A, Signal Generator, 0.5-512MHz ... $700
8640B, Signal Generator, Opt. 002, .5-1024MHz ... $2100
8640B, Signal Generator, Opt. 1, 2 ... $2200
8654A, Signal Generator, 10-520MHz ... $450
8656A, Signal Generator, 100KHz-990MHz ... $1700
8656B, Signal Generator, 0.1-990MHz w/Opt. 02 ... $2250
8660C, Synth. Signal Generator w/Opt. 1 & 100 ... $1000
86603A, RF Plug-In, 1-2600MHz ... $800
86603A, RF Plug-In, 1-2600MHz w/Opt. 02 ... $950
8662A, Synthesized Signal Generator, 10KHz-1280MHz ... $13,000
8663A, Synthesized Signal Generator, 100KHz-2560MHz ... $27,500
8671B, Synthesized CW Generator ... $5500
8672A, Synth. Signal Gen., 2.0-18.0GHz ... $3500
8672A, Synth. Signal Gen., 2GHz-18GHz, w/Opt. 08 ... $4500
8748A, S-Parameter Test Set w/Opt. 026 ... $1350
8756A, Scalar Network Analyzer ... $1500
8757A, Scalar Network Analyzer, 10MHz-60GHz ... $4000
8970A, Noise Figure Meter ... $4500

TEKTRONIX

11A32, Two Channel Amplifier Plug-In, DC-400MHz ... $1250
11A34, Four Channel Amplifier Plug-In, DC-300MHz ... $1500
11A52, 600MHz Two Channel Vertical Amplifier ... $700
1503, TDR Cable Tester w/Opt. 04 Recorder ... $1550
1503B, TDR Cable Tester w/Opt. 04 ... $2450
2215, 60MHz Oscilloscope ... $500
2236, 100MHz Oscilloscope w/Counter/Timer/DMM ... $700
2246, 100MHz Oscilloscope ... $1600
2247A, 100MHz Oscilloscope w/Counter/Timer/Voltmeter ... $2500
2337, 100MHz Oscilloscope w/DMM ... $1650
2430A, 150MHz Digital Oscilloscope ... $2350
2430R, 150MHz Digital Storage Oscilloscope ... $1850
2432A, 300MHz Digital Storage Oscilloscope ... $3000
2445, Four Channel 150MHz Oscilloscope ... $1500
2465, Four Channel 300MHz Oscilloscope ... $2000
2465A DV, Four Channel 350MHz Oscilloscope ... $3850
2465CTS, Four Channel 300MHz Oscilloscope w/CCT/WR ... $2500
2467, Four Channel 350MHz Oscilloscope ... $3000
2467B, Four Channel 400MHz Oscilloscope ... $4500

VISIT OUR WEBPAGE AT WWW.RSSURPLUS.COM

2630, Fourier Analyzer ... $2500
466, 100MHz Storage Oscilloscope w/DM44 ... $800
475, 200MHz Oscilloscope ... $650
475A, 250MHz Oscilloscope ... $800
492P, Programmable Spectrum Analyzer, 50KHz-21GHz w/Opt. 1/2/3 ... $7000
577/D2, Curve Tracer, Non-storage w/177 Fixture ... $1750
7D20, Programmable Digitizer ... $400
7L5/L3, Spectrum Analyzer, 20Hz-5MHz, w/Opt. 025 Tracking Generator ... $1850
7L12, Spectrum Analyzer, 100KHz-1.8GHz ... $1500
7L18, Spectrum Analyzer Plug-in, 1.5-18GHz Capable of 60GHz with Mixers ... $2500
7S12, TDR/Sampler ... $450
TM5003, Three Slot Power Mainframe ... $450
TM5006, Six Slot Power Mainframe ... $550

MISCELLANEOUS

Acme Elect. PS2L1000, Electronic Load ... $850
Datron 1061A, 6.5 Digit Autocal Multimeter, DC Only ... $700
Datron 1062, 6.5 Digit Autocal Multimeter, DC/AC/Ohms ... $900
EIP 545A, Microwave Frequency Counter ... $800
EIP 548A, Frequency Counter, 10Hz-26.5GHz ... $2000
EIP 548B, Frequency Counter, 10Hz-26.5GHz ... $3250
EIP 578, Source Locking Frequency Counter ... $2500
Fluke 5100B, Voltage Calibrator W/Opt. 03 & 05 ... $2500
Fluke 5200A, AC Voltage Calibrator w/5205A Amp ... $1850
Fluke 7261A, Universal Counter/Timer, 0Hz-125MHz ... $350
Fluke 8010A, Digital Multimeter ... $175
Fluke 8012A, Digital Multimeter ... $175
Fluke 8050A, Digital Multimeter ... $250
Fluke 8502A, Digital Multimeter, DC Only ... $225
Fluke 8520A, Digital Multimeter ... $350
Fluke 8600A, Digital Multimeter ... $65
Fluke 8810A, Digital Multimeter ... $250
Fluke 8840A, Digital Voltmeter w/Opt. 059 ... $600
Keithley 195A, Digital Multimeter ... $700
LeCroy 7200, Precision 400MHz Digital Oscilloscope w/ (2) 7242B Plug-Ins ... $7000
LeCroy 9450, 350MHz High Performance Digital Oscilloscope ... $3250
Marconi 2019A, Signal Gen., 80KHz-1040MHz ... $2200
Polarad 1105E-FT, Signal Generator, 0.8-2.4GHz ... $400
PTS 500, Frequency Synthesizer, 1-500MHz ... $450
Systron Donner 6530, Frequency Counter 10Hz-26.5GHz ... $1000
Trans. Devices DLR400-15-2500A, Dynamic Load ... $1500
Trans. Devices DLVP 130-110-1000 Electronic Load ... $950
Valhalla 2703, AC Voltage Standard ... $2350
Wavetek 171, 2MHz Synth. Function Generator ... $450
Wavetek 178, Automatic Synthesizer ... $1700
Wavetek 852, Dual Hi/Lo Filter ... $1000
Wavetek 2001A, Sweep Generator, 1-1400MHz ... $450
Wavetek 2500A, Signal Generator, .2-11MHz ... $2250
Wavetek 3000-200, Signal Generator ... $900
Wavetek 8003, Precision Scalar Analyzer, 10MHz-40GHz ... $2000
Wavetek 8501, Peak Power Meter ... $2000
Wiltron 560-7S50, RF Detector, 10MHz-18.5GHz ... $300

MasterCard **R & S Surplus** VISA
1050 E. CYPRESS STREET, COVINA, CA 91724
(626) 967-0846 · FAX (626) 967-1999

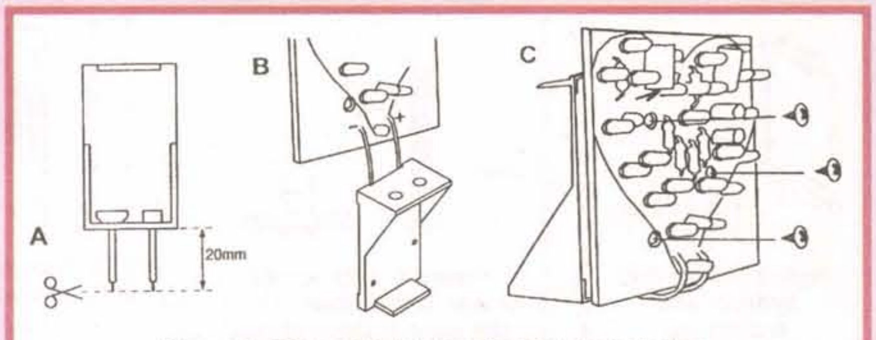


Figure 9: Nine-volt battery holder installation.

base) matches the flat spot on the part layout drawing, Figure 3.

The orientation of the transistors will be as shown in Figure 7, if you use the BC547B transistors. However, as mentioned earlier, if you use 2N3904 or equivalent transistors, they must be reversed, facing the opposite direction.

Figure 8 shows the orientation of the electrolytic capacitors. Figure 9-A indicates you should cut off the leads on the kit-supplied nine-volt battery holder at about 20mm (about .75-inches) and trim the ends; 9-B shows the installation; and 9-C shows how the three kit-supplied screws are used to mount the battery holder to the back of the PC board through three existing holes in the board.

Testing

To see how the "hearts" work, simply plug a regular nine-volt transistor radio battery into the snaps on the battery holder, observing polarity. Since there is no switch, the inner and outer heart shapes should immediately start blinking alternately. To stop the blinking, disconnect the battery.

Troubleshooting

While there is nothing complicated about this circuit, a single bad solder joint or a part installed "backwards" can create havoc with the display. If things don't work as they should, you'll need a magnifying glass and a multimeter to do some troubleshooting.

SAME DAY PROTOS

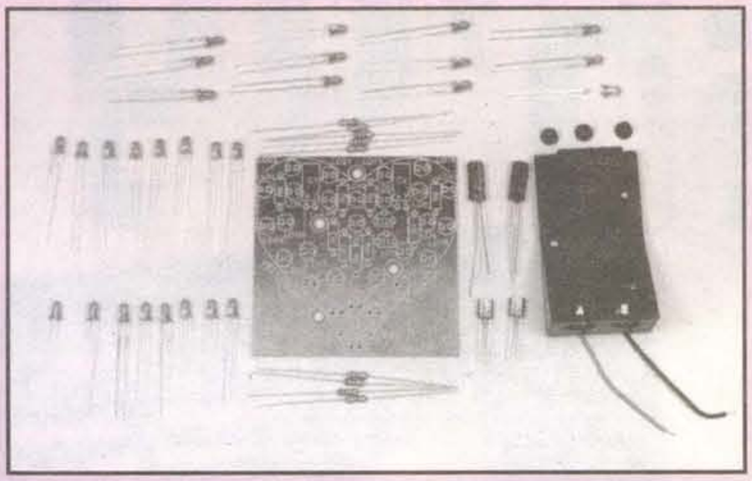
Modem Gerber files before 9 AM EST.
We ship the boards same day.
Multilayers NEXT DAY.

Service:

- Instant Quotes
- Routing / Scored Panels
- Single / Double / Multi-Layers
- Blind and Buried Vias
- SMOBC and LPI
- Electrical Testing
- Thru Hole or SMT
- Carbon Ink / Peelable Mask
- Nickel and Gold Plating
- UL Approved

CHICAGO CIRCUITS CORPORATION
Manufacturer of Printed Circuit Boards
2685 UNITED LANE
ELK GROVE VILLAGE, IL 60007
E-MAIL: sales@chicagocircuits.com
TEL: (847) 238-1623 • FAX: (847) 238-9160
MODEM: (847) 238-1728

Write in 162 on Reader Service Card.



The kit includes all the parts, as well as an etched, drilled, and silkscreened printed circuit board, and a battery holder.

Don't let this scare you! Your project should work properly if you are careful in assembling it. But, just in case ...

If the project is not operating properly, typically, either some of the strings of LEDs will not light, or they will not alternate. Using a magnifying glass, check that all the LEDs are properly oriented (all flat spots on the base face the same way), and that the two capacitor negative leads are properly placed. As for the transistors, it depends which ones you use; the ones supplied with the kit should be oriented as shown in Figure 3. If you use the 2N3904 transistors, they should be facing the opposite way.

Be sure resistors R8 (orange, orange, orange) and R9 (brown, black, yellow) and R1-R7 (brown, red, red) are properly placed as shown in Figure 3.

Assuming all the parts are properly placed and oriented, you probably have a bad solder joint. (While an individual part may be bad, this is the *least* likely problem!) Using a magnifying glass, look for smooth, shiny, pyramid-shaped joints. If a joint is gray or grainy, touch it with a hot soldering iron — and maybe a bit of solder — until it looks right.

If the unit still does not operate properly, you can check each LED by using a nine-volt battery, two clip leads, and a 1,000-ohm current-limiting resistor in series with one of the leads.

With the back of the board facing you, and using a mirror to see the front side of the board, touch the leads to each pair of individual LED solder joints, making sure the positive lead is touching the anode (non-flat-side) of the LED. The individual LED should light brightly. If it doesn't, it is defective and should be changed.

Since testing the transistors, capacitors, and resistors, once they are soldered into the circuit board is impractical, the next best thing is a continuity check.

Using the ohmmeter function of a multimeter, set it to the lowest range and check the printed circuit paths between solder joints. A broken printed circuit trace may be too small to be noticed by eye alone, but will be immediately apparent with a continuity check.

You can also use a nine-volt battery and the voltmeter function of your multimeter to check that you have nine volts at the "top" (looking at Figure 1) of each of the LED strings, and R8 and R9. No voltage, no current.

Alternate Power

The nine-volt battery is being drained at the rate of about 10 milliamperes. Using a common nine-volt general-purpose rectangular battery, this should last for eight days if used four hours a day, or only one day if used continuously. Obviously, this could become expensive if you plan to have the heart "throbbing" all the time.

The solution is to use any of a number of wall-plug transformers that offer multi-voltages, polarity selection, and a nine-volt battery snap as one of the output connectors, such as the Mouser 41AC116 Universal Adapter ($6.29). NV

Parts List

C1, C2
22uF 25V electrolytic capacitor
LD1-LD28
1/8-inch (3mm) diameter high-efficiency red light-emitting diodes (see text)
R1-R7
1.2K 1/8-watt 5% carbon film resistor
R8
33K 1/8-watt 5% carbon film resistor
R9
100K 1/8-watt 5% carbon film resistor
T1, T2
BC547B NPN silicon transistor (see text)
Miscellaneous: Printed circuit board, 9V battery holder, three mounting screws.

Sources

All of the items in the Parts List are supplied in the MK101 Flashing LED Sweetheart Kit from a Velleman distributor for $12.95 plus shipping and handling. Call **(817) 284-7785** for a list of US distributors or to request a free catalog.
Web site: www.velleman.be
E-Mail: velleman@earthlink.net

If building from scratch, parts (but not the PC board) may be ordered from
Mouser Electronics
1-800-346-6873
www.mouser.com or
sales@mouser.com

EPROM+

A device programming system for design, repair and field service

◆ *EXCEPTIONAL POWER FOR THE PRO*
◆ *EASY-TO-USE FOR THE NOVICE*

Here's what you get: A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters*. Comprehensive, easy-to-use software which is specifically designed to run under DOS, Windows 3.1, 95 and 98 on any speed machine. The software has features which let you **READ**, **PROGRAM**, **COPY** and **COMPARE** plus much more. You have full access to your system's disk including **LOADING** and **SAVING** chip data plus automatic processing of **INTEL HEX**, **MOTOROLA S-RECORD** and **BINARY** files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

Broad device support: Including **FIRST GENERATION EPROMS** (2708, TMS2716*, 25XX etc.) **SECOND GENERATION EPROMS** (2716-27C080)(8 MEG), **40 and 42 PIN EPROMS*** (27C1024-27C160)(16 MEG) **EEPROMS** (2816-28C010) PLUS **ER5901**, **FLASH EPROMS** (28F,29C,29EE,29F)(32 MEG), **NVRAMS** (12,20,X2210/12) **8 PIN SERIAL EEPROMS*** (24 ,25 ,85, 93, 95, 80011A) PLUS **ER1400/M58657*** **BIPOLAR PROMS*** (74S/82S), **SERIAL FPGA CONFIGURATORS** (17CXXX) **MICROS*** (874X,875X,87C5X,87C75X,89C) **ATMEL MICROS***(89S,90S)(AVR) **PIC MICROS*** 8, 18, 28, 40 PIN (12CXXX,16C5X,6X,7X,8X PLUS FLASH & 17C) **MOTOROLA MICROS*** (68705P3/U3/R3, 68HC705C8/C9/J2/P9, 68HC711E9/D3)

$289

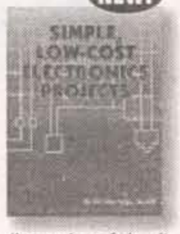
☐ **Includes step-by-step tutorial plus explanation of EPROM fundamentals**
☐ **1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE**
***REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF)**

$5.00 SHIPPING ◦ $5.00 C.O.D.
VISA • MASTERCARD • AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OHIO 45150
(513) 831-9708 FAX (513) 831-7562
website - www.arlabs.com email - arlabs@worldnet.att.net MADE IN THE U.S.A.

Great Books for Hobbyists, Students, Engineers . . .

Simple, Low-Cost Electronics Projects
by Fred Blechman
NEW!



Learn electronics with Fred Blechman's exciting new book. Begin with simple designs and progress to more sophisticated projects. Each project comes with a complete discussion of circuit theory and parts list, as well as information on troubleshooting and testing. Build voltmeters and multimeters, inductance and semiconductor testers, variable frequency audio oscillators, a photoelectric counter, and much more!
1-878707-46-9/224 pages/$19.95

Controlling the World with Your PC
by Paul Bergsman

PC Disk Included! Connect your computer to the real world and make it do useful work like controlling stepper motors, turning appliances on and off, or monitoring fluid levels. PC disk contains software files in ready-to-use form.
1-878707-15-9/208 pages/$35.00

The Forrest Mims Engineer's Notebook
by Forrest Mims III

This revised edition of Forrest's classic book includes hundreds of useful circuits built from integrated circuits and other parts available from convenient sources.
1-878707-03-5/156 pages/$19.95

The Integrated Circuit Hobbyist's Handbook
by Thomas R. Powers

Covers the major types of integrated circuit devices—linear, TTL, and CMOS—and provides complete details and theory about their operation. Contains lots of useful application circuits—an essential reference for every hobbyist. **1-878707-12-4/256 pages/$19.95**

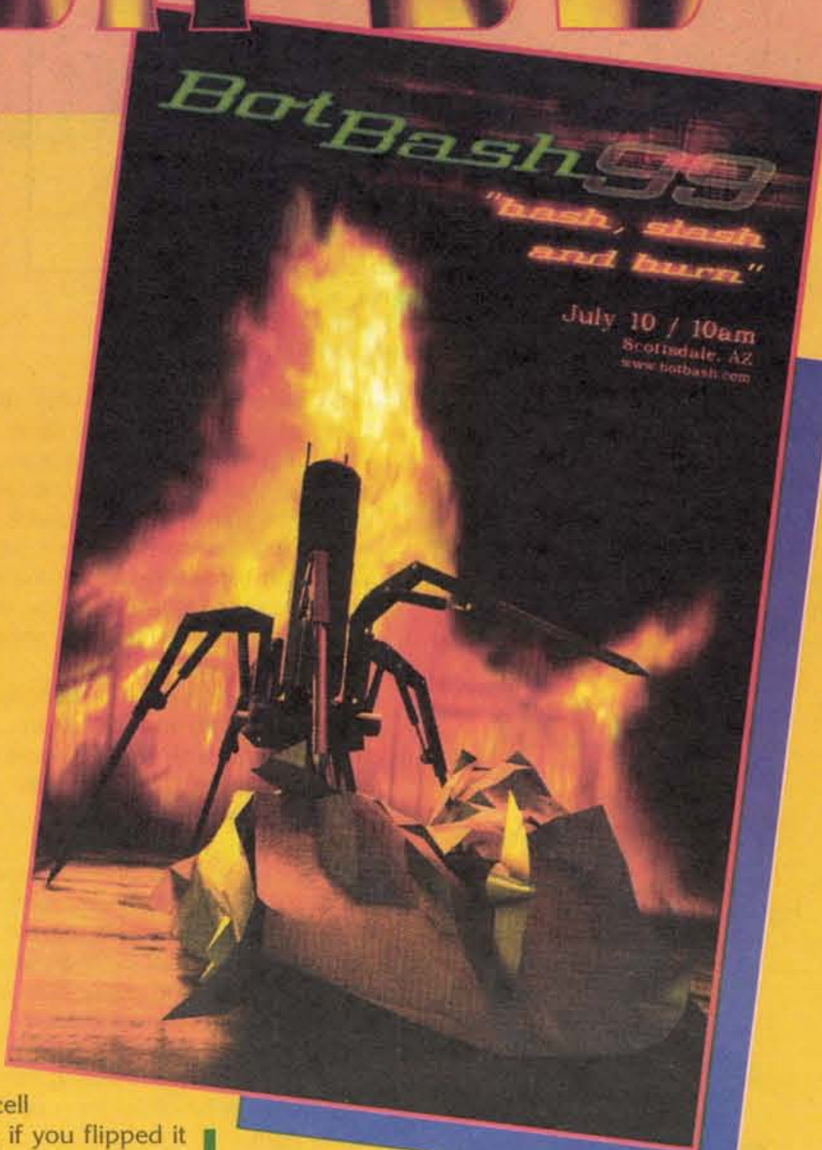
Order on the Web!
For these and other great books on electronics, visit:
www.LLH-Publishing.com
or
call 1-800-247-6553 to use a major credit card, or send check or money order to:

LLH
Technology Publishing
3578 Old Rail Road
Eagle Rock, VA 24085

by Dan Danknick

BotBash'99

MECHADON



Sometimes, it's just easier to build something new than fix something old. That realization drove Mark Setrakian, builder of the "Snake" robot featured in the May '98 issue of *Nuts and Volts*, to abandon it in favor of a new project for the fighting robot events of 1999-2000.

Rising on six talon-shaped legs, "Mechadon" walked into the arena at the BattleBots event on August 14th to the amazement of all gathered around. "What people think of in a fighting robot is something animal — a big bug." This kind of pest would require a forklift or bazooka to squash, however.

Explaining that his goal was to create a machine with as many degrees of freedom as possible with a minimum number of servos, Mechadon really makes you stop to wonder: How did he do that? Each leg utilizes two linear actuators balanced with a fixed length spar to create motion in the X-Y plane of the floor. This, in itself, isn't enough for a walking gait without scraping along the ground so two body pivots swing the legs vertically into the Z axis to complete the sequence.

"Subconsciously, the viewer will compare it to a crab or bug. But when it flips on its back and the center sections begin to windmill, it's caught you off guard — now it's a machine!" explains Mark on the subtle surprise of watching it in action for the first time. Weighing in at 435 lbs., the forces involved are truly surprising, as well. Each leg can push with 800 lbs. at the toe, while each waist pivot has a peak torque over 31,000 in-lb. It is powered by 160 volts of gel-cell batteries. How large is it? "Well, if you flipped it over and put a sheet of glass on its toes, it would make a nice dining room table to comfortably seat eight."

"It's been in the back of my head to build a big walking robot since 1994." After experimenting with various walking methods through R/C hobby servos and popsicle sticks, Mark laid out the basic design in two days. The following four weeks were spent machining and welding it into shape from materials "I could get down the street," mostly aluminum and steel. It is electrically complex with 14 industrial servo amplifiers, each controlling a motor with positional feedback. "There were no huge problems but a lot of little ones. That in itself is taxing."

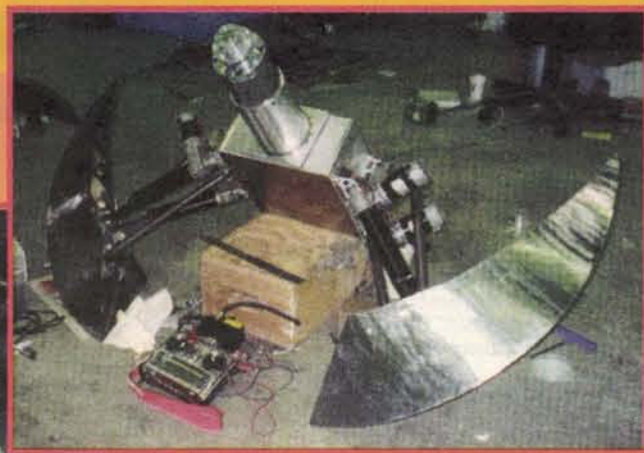
Currently, Mechadon is entirely puppeted through an R/C radio link. A complex stick mix delivers nine channels of control, but Mark has plans for the future to expand it all the way to the full 14. "A hobby of mine is music, so I'm going to control this with MIDI."

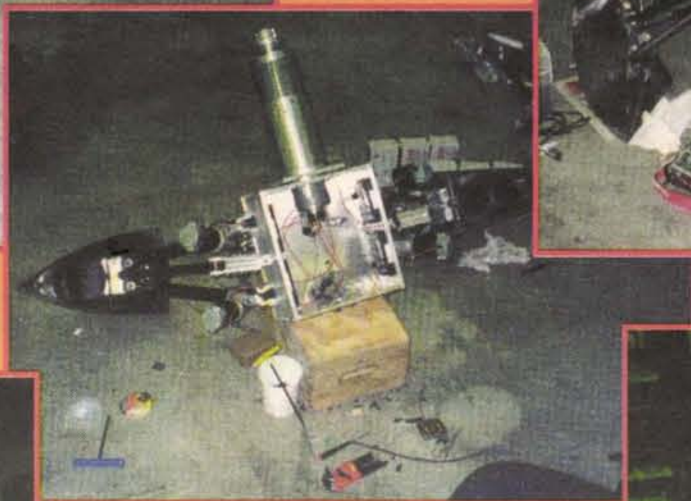
Using a Macintosh program called MAX, he has created high-level macros that command the independent motion profiles to create complex movements. He then plays these back though a special analog interface that overrides the controls on two R/C transmitters. By varying the speed of the playback, the man-machine interface becomes very intuitive: "step forward," "run back," "step left," "strike" etc. Not to mention the scheme is very stable: "That's the only way I could ever ride this into the arena."

Mark works as the chief Creature Mechanic for Rick Baker's Cinovation Studios in Burbank, CA. His recent work includes design and construction of the animatronics in the film "Mighty Joe Young" while he is currently working on an adaptation of "The Grinch That Stole Christmas." Explaining his philosophy of anthropomorphic design, "Studying anatomy can be interesting, but creatures are made from bones and sinew, while you're working with metals and cable. I strive to make things move in a naturalistic way, not technically accurate. If it looks good then how you did it is irrelevant."

To many of us, this is an amazing project that generates the obvious "Where would I start?" question. Mark offers us this encouragement: "I don't feel anyone has limits when they work their way up to something. This was my most ambitious project yet. And my next robot will also be my most ambitious effort." NV

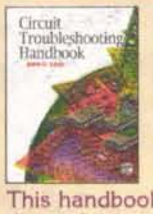
Mark's webpage is at www.teamsinister.com. AX software is by Opcode Systems, www.opcode.com. The author can be reached at dan@teamdelta.com.





Expand your mind in the new millennium ... Read a book!

AND GET A 10% DISCOUNT OFF THE LISTED PRICE AS A PAID SUBSCRIBER TO NUTS & VOLTS!



$39.95
"Circuit Troubleshooting Handbook"
by J. Lenk

This handbook gives full descriptions of the operation of important circuits, and how each circuit's characteristics may figure in its failure or poor performance.

$39.95
"Encyclopedia of Electronic Circuits" Vol. 7
by R. Graff

An extensive library of 1,000 circuits from the bestselling, seven-volume "Encyclopedia of Electronic Circuits."

$54.95
"Handbook of Microcontrollers"
by M. Predko

This much-needed reference is the first to cover all the most common types of eight-bit microcontrollers.

$24.95
"How Electronic Things Work ... and What to Do When They Don't"
by R. Goodman

Never again be flummoxed, flustered, or taken for a ride by a piece of electronic equipment with this fully illustrated, simple-to-use guide.

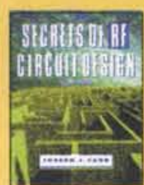
$34.95
"Programming and Customizing the BASIC Stamp Computer"
by S. Edwards

Build smart electronics projects with the inexpensive, simple-to-use, surprisingly powerful BASIC Stamp.

Call 1-800-783-4624 today!

WE ACCEPT VISA AND MASTERCARD

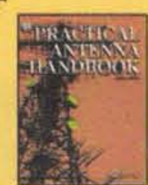
by Joseph J. Carr



SECRETS OF RF CIRCUIT DESIGN

$29.95

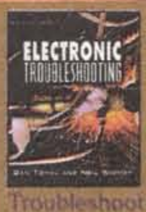
From one of today's most respected electronics authors comes this pragmatic, intermediate-level guide to designing, building, and testing all types of radio frequency circuits. Filled with functional projects that demonstrate the principles of RF circuits, this revision of a bestseller also provides a handy parts list and sources of components.



PRACTICAL ANTENNA HANDBOOK

$49.95

The most popular book on an-tennas ever written, widely known as "the antenna builder's bible." This *Third Edition* is a work for anyone with an interest in antennas, from the newest of novices to the most experienced engineer. This empowering book gives you all kinds of projects and material that explains why what you did works.

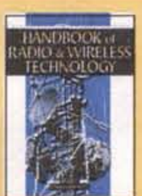


$34.95
"Electronic Troubleshooting"
by D. Tomal and N. Widmer

Troubleshoot and repair any type of electronics with this comprehensive guide.

$39.95
"Programming and Customizing the 8051 Microcontroller"
by M. Predko

This tutorial/disk package details the features of the 8051 and demonstrates how to use these embedded chips to access and control many different devices.



$44.95
"Handbook of Radio and Wireless Technology"
by S. Gibilisco

A comprehensive compendium on the entire field of radio and wireless technology.

BOOKS PUBLISHED BY MCGRAW HILL

Send check or money order to Nuts & Volts, 430 Princeland Court, Corona, CA 92879. Include a complete shipping address (no P.O. Boxes, please). Shipping & handling $4.50. CA residents add 7.75% sales tax. Or, call our toll-free order-only line at 1-800-783-4624 and use your MasterCard or Visa. *ALL ORDERS MUST BE PREPAID.*

OTHER AVAILABLE TITLES ...

"The Illustrated Dictionary of Electronics"
by S. Gibilisco **$39.95**

"The Robot Builder's Bonanza"
by G. McComb **$18.95**

"Programming and Customizing the PIC Microcontroller"
by M. Predko **$34.95**

"How Radio Signals Work"
by J. Sinclair **$24.95**

"Making Printed Circuit Boards"
by J.L. Axelson **$22.95**

"TAB Encyclopedia of Electronics for Technicians and Hobbyists"
by S. Gibilisco **$69.50** *(Hard Cover)*

"How to Read Electronic Circuit Diagrams"
by R.M. & Lawrence Brown **$19.95**

"Build Your Own Test Equipment"
by H.L. Davidson **$22.95**

"Radio Receiver Projects You Can Build"
by H.L. Davidson **$21.95**

"Basic Electronics Theory"
by D.T. Horn **$26.95**

"Troubleshooting and Repairing Consumer Electronics Without a Schematic"
by H.L. Davidson **$24.95**

"Amateur Radio Encyclopedia"
by S. Gibilisco **$50.00** (Hardcover Only)

"Ready-to-Build Telephone Enhancements"
by D.T. Horn **$17.95**

"The Benchtop Electronics Handbook: 260 Most Common Popular Electronics"
by V. Veley **$65.00** *(Cloth Cover)*

INTRODUCTION

In 1995, I developed an AC-DC voltage reference which I called the model 304. It worked well, but it used a precision +5 volt DC reference IC, 12 opamps, and five other support ICs to do the job. I have included its block diagram as Figure 1.

The circuit starts with IC1, the precision +5 volt DC reference (more about this later). Positive and negative 10 volts DC for the output are produced by amplifiers IC2 and IC3. IC4 buffers the +5 volts and IC5 inverts it to apply plus and minus 5 volts to IC6, an electronic SPDT switch driven by 1 kHz from a crystal-controlled oscillator.

The resulting 10-volt peak-to-peak squarewave is buffered by a voltage follower (not shown) and goes to an output terminal.

The squarewave is also converted to a low-distortion sinewave by an active lowpass filter (IC8, 9, and 10). Then it's converted back to DC by IC12 and 13. By adjusting the gain of IC11, you can set its output to precisely 10 volts RMS (±0.1%) because the summing amplifier (IC14) balances the +10 volts from the DC converter with -10 volts (from IC2) for a zero or null output at "Test Point."

In 1998, Thaler Corporation (Tucson, AZ) developed an IC that let me redesign the reference circuit for a much lower parts count and no calibration adjustment. The Thaler SWR300 is a precision sinewave oscillator which is frequency programmable with two external capacitors.

In this article, I'm going to describe an improved AC-DC voltage reference which I am calling the model 305. Its block diagram is shown in Figure 2. It is useful for calibrating AC and DC voltmeters and 'scopes, and it uses standard, off-the-shelf parts. It can be as accurate as ±0.1% and it has no calibration adjustments — just build it and use it!

AN IMPROVED AC-DC VOLTAGE REFERENCE

by Ron Tipton

This article describes an improved AC-DC voltage reference. It is useful for calibrating AC and DC voltmeters and 'scopes, and it uses standard, off-the-shelf parts. It can be as accurate as ±0.1% and it has no calibration adjustments — just build it and use it!

HOW DOES IT WORK?

The DC portion of the reference still uses a precision +5 volt reference IC and I've listed the specifications on some of the available devices in the Table. As you can see, there is quite a bit of difference in performance, but pin-outs are often the same between manufacturers so you can "plug-in" the performance you need. I think you get the best performance per buck from the Thaler VRE305C.

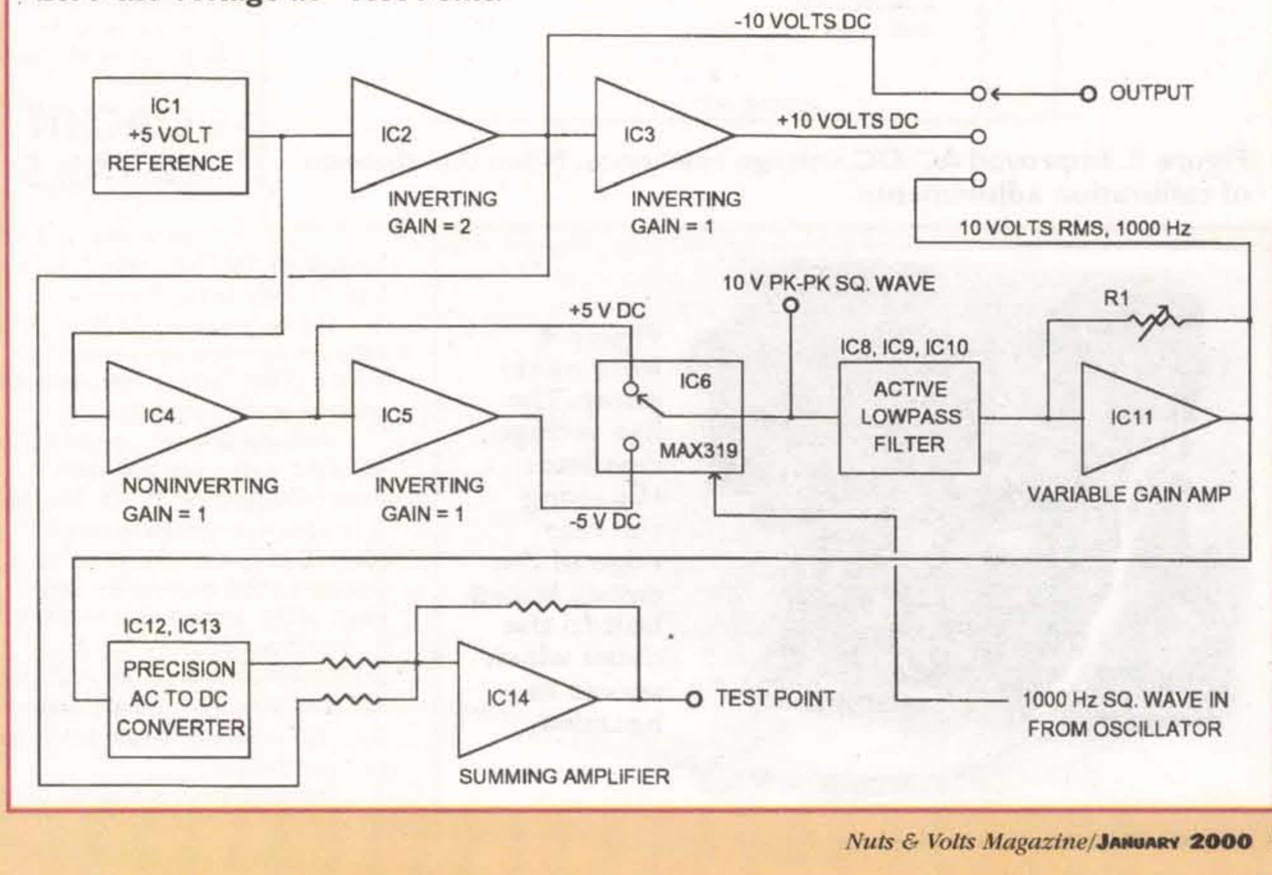
Now let's take a look at the Figure 2 block diagram. The DC portion starts with IC1, the +5 volt reference selected from the Table. A times two inverting amplifier gives us -10 volts which drives a unity gain inverting amplifier for +10 volts. One of these voltages or the AC voltage (which we'll talk about next) is selected by a front panel rotary switch. From the switch, the selected voltage goes either to an internal voltage divider or to output terminals to drive an external voltage divider — more about this later.

IC8 is the SWR300 which produces an output voltage of 7.071 volts RMS (±0.1%). This may seem an odd choice, but it's actually very easy to amplify this to 10 volts RMS.

I used ±0.1% metal film resistors in the IC9 opamp circuit, but you need only three of them so the expense is minimal. I set the frequency to 1,000 Hz with a pair of 0.01 uF (±5%) metalized polyester film capacitors (C3 and C5).

The SWR300 also has a buffered cosine output which I used to drive the zero crossing detector. This has no significance other than

Figure 1. Block diagram of original AC-DC voltage reference. R1 is adjusted to zero the voltage at "Test Point."



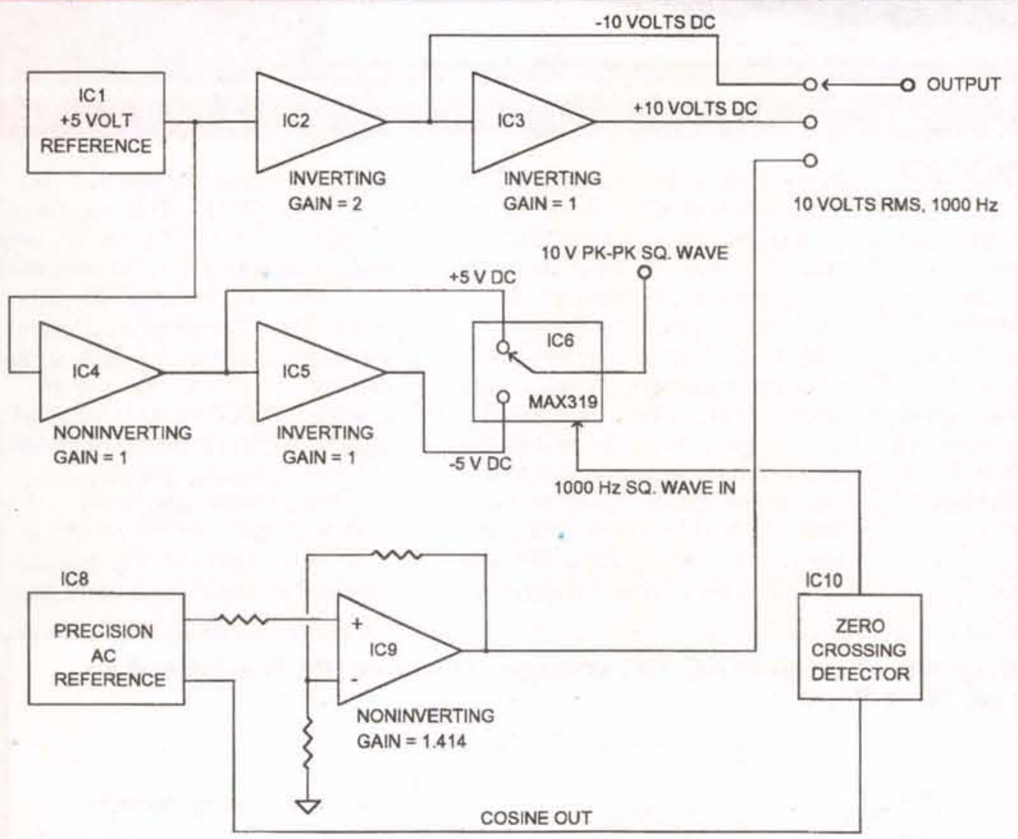


Figure 2. Improved AC-DC voltage reference. Note the absence of calibration adjustments.

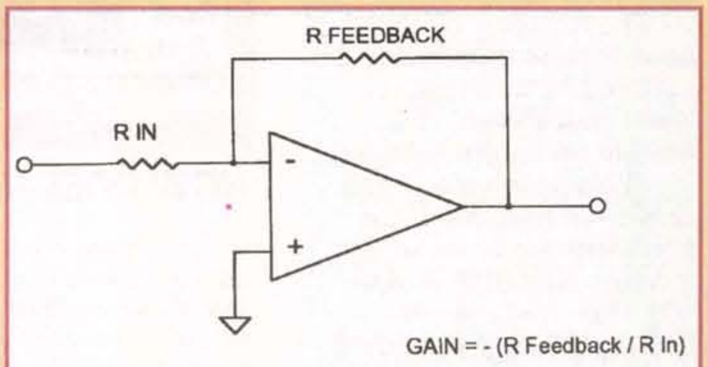


Figure 3. Gain of inverting op-amp depends only on the ratio of resistors.

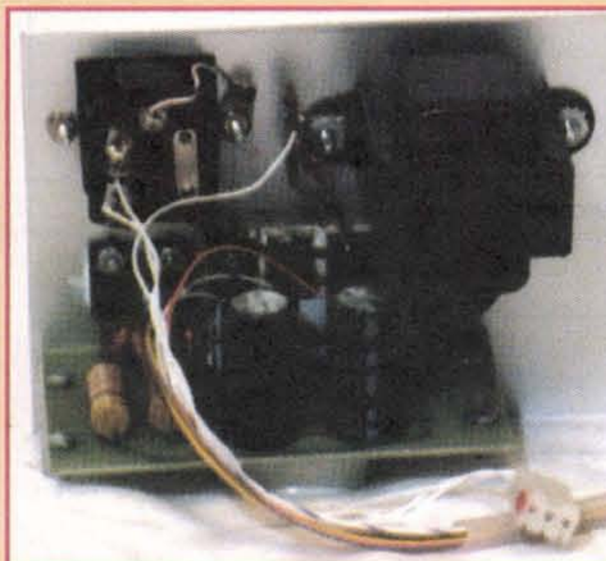


Figure 4. Rear panel photo. The five voltage regulator ICs along the rear edge of the circuit board bolt to the panel which serves as a heatsink.

it saved having to use another opamp in the circuit as a buffer.

The zero crossing detector (an LM393 comparator) produces a 1,000 Hz CMOS level squarewave which is compatible with the input needs of the electronic switch (IC6).

CIRCUIT DETAILS

Now that you know how the "box" works, let's look at some circuit details.

The opamp type is critical because we need low noise, low output offset voltage, and moderate price all at the same time.

After considering several types, including a chopper stabilized model, I settled on the OP-07. The commercial temperature version (OP-07D) has a maximum offset voltage of 150 microvolts, a maximum offset voltage drift of 0.6 microvolt per degree C, and is priced at less than $2.00. And "typical" performance is usually better than the maximum values listed on the spec sheet.

The next detail is how do we manage to get the DC accuracy we need with inexpensive resistors? To answer this, we need to review a bit of opamp theory.

In an inverting amplifier, the gain is set by the ratio of the value of the feedback resistor to the input resistor as shown in Figure 3. If both resistors are, for example, 10K ohms, we have a gain of -1. However, if both resistors are 9973 ohms, we still have a gain of -1.

With three matched resistors we get a gain of -2 for opamp IC2 by using two matched resistors in series as the feedback resistor. Thus, we see it's not the absolute value of the resistance that is critical, but just the ratio.

We can use 1% metal film resistors (which are very inexpensive) by matching them to 0.1% or better. All you need is your digital multimeter (DMM) set to an ohms scale.

A 3-1/2 digit meter gives you a resolution of 10 ohms (0.1%) for 10 Kohm resistors.

A 4-1/2 digit meter is 10 times better (0.01%). It doesn't even matter if your ohmmeter is accurate, as long as it's stable! For example, suppose it reads 43 ohms too high. The matched resistors are off by 43 ohms, but they still match and that's what counts.

You can easily determine stabili-

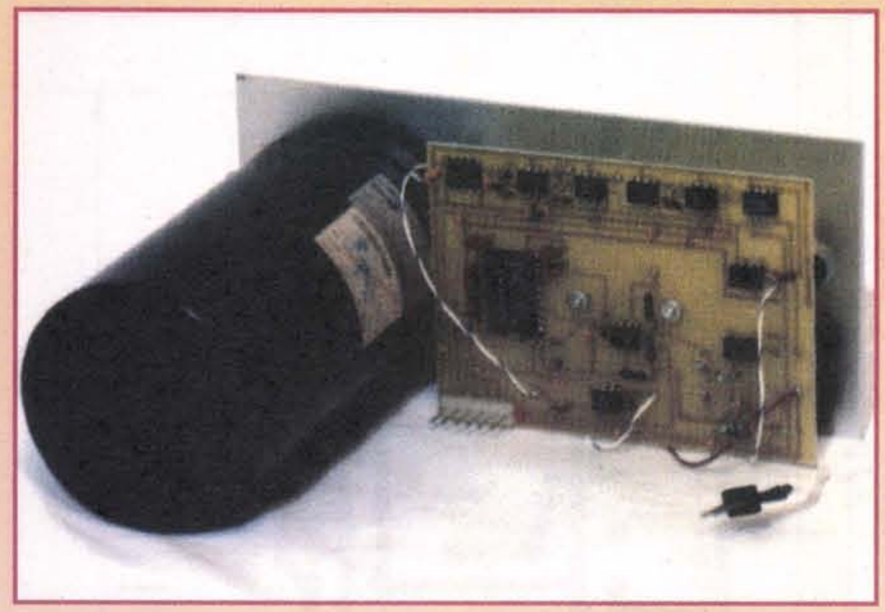


Figure 5. Front panel photo showing an internal voltage divider. The power on-off switch, power-on indicator, and output binding posts are between the circuit board and the panel.

ty by rechecking matched pairs after 30 minutes or so.

CONSTRUCTION

The first step is to make the circuit boards and I've included the layout artwork here. You can also download it in SuperCAD format (Mental Automation, Inc.) from our Web site; see the Resource List.

Most of the components are mounted on two PC boards: one board for the power supply and one for everything else.

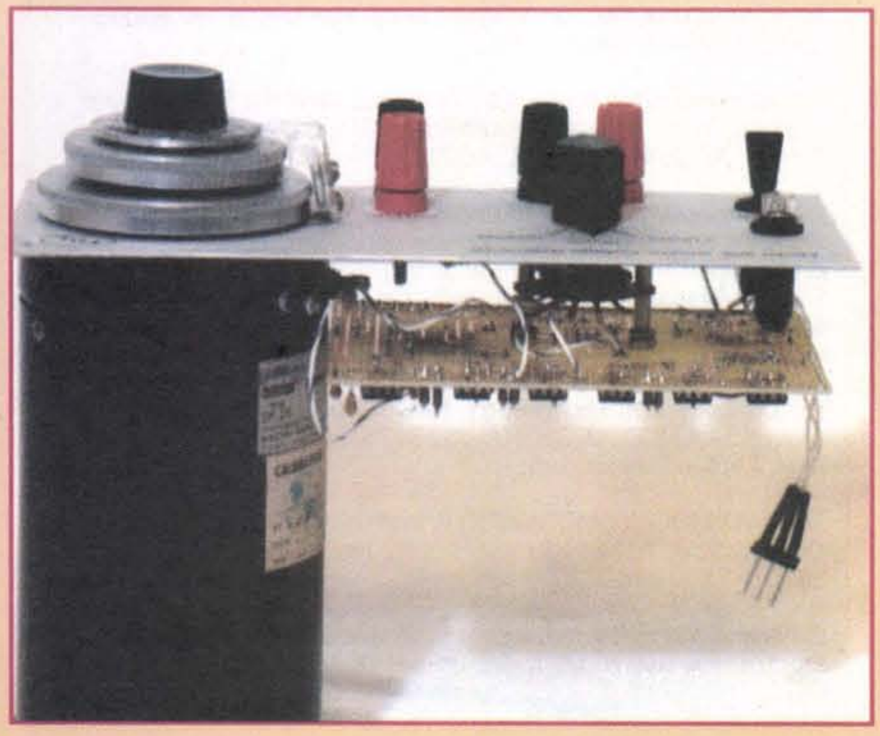
All power supply parts (except the on/off switch and power-on indicator) mount on the cabinet rear panel. All voltage reference components (plus the power switch and indicator) mount on the front panel.

The panels are interconnected with two cable and connector assemblies: one for DC power and the other for AC line power. The photos in Figures 4 through 6 will help make this clear.

Both boards are single-sided as a few jumpers are usually preferable to having to make double-sided boards.

Let's begin construction with the power supply board by placing its two jumpers as shown on the parts placement diagram in Figure 7. Placement of the rest of the parts is not critical except for the regulator ICs, just remember to carefully check the polarities of the electrolytic capacitors and diodes.

Figure 6. The reference circuit board is mounted on rotary switch, S1. The switch then attaches the board to the front panel. This low-stress mechanical mounting helps insure good electrical performance.



AST GLOBAL ELECTRONICS

24529 STATE HWY. 408, CAMBRIDGE SPRINGS, PA 16403
VOICE 814-398-8080 · 1-888-216-7159 · FAX 814-398-1176

VIEW COMPLETE LISTING AT: http://www.astglobal.com

IF WE DON'T CARRY IT ... WE'LL FIND IT QUICKLY ... AT REASONABLE PRICES.

EIP 545, Microwave Counter 18GHz	$500
EIP 931, Microwave Source, .01-18GHz, Opt. 9320 SPECIAL	$3,200
Fluke 845AB, Null Detector/Micro Voltmeter 1uV-1000VDC	$375
Fluke 5100B, Multifunction Calibrator, Opt. 03/05	$2,800
Fluke 5100B, Multifunction Calibrator	$2,400
Fluke 5200A, Programmable AC Calibrator	$1,000
Fluke 5215A, Precision Power Amp	$800
Fluke 6070A, Synthesized RF Signal Generator 200KHz-520MHz	$1,400
Fluke 8050A, DMM 4-1/2 Digit w/Battery Pack	$145
Fluke 8050A, DMM 4-1/2 Digit w/o Battery Pack	$145
Fluke 8520A, DMM 5-1/2 Digit	$275
Fluke 9010A, Micro System Troubleshooter	$375
General Radio 1658, Digibridge	$475
Gigatronics 6061A, Synthesized Signal Generator 10KHz-1050MHz	$2200
HP 141T, Spectrum Analyzer Mainframe	$475
HP 141T, Spectrum Analyzer w/8552A/8553B, 1KHz-110MHz	$1,000
HP 141T, Spectrum Analyzer w/8552B/8553B, 1KHz-110MHz	$1,200
HP 141T, Spectrum Analyzer w/8552B/8556A, 20Hz-300KHz	$1,100
HP 141T, Spectrum Analyzer w/8552B/8554B, 1KHz-1.2GHz	$1,700
HP 141T, Spectrum Analyzer w/8552B/8555A, 10MHz-18GHz	$1,900
HP 334A, Distortion Analyzer	$275
HP 400EL, AC Voltmeter, 10Hz-10MHz	$150
HP 400FL, RMS Voltmeter, 20Hz-4MHz, 100uV-300V	$175
HP 415E, SWR Meter	$100
HP 432A, Power Meter w/Cable/8478, .01-18GHz Sensor	$350
HP 436A, Power Meter w/8481H Sensor/Cable SPECIAL	$975

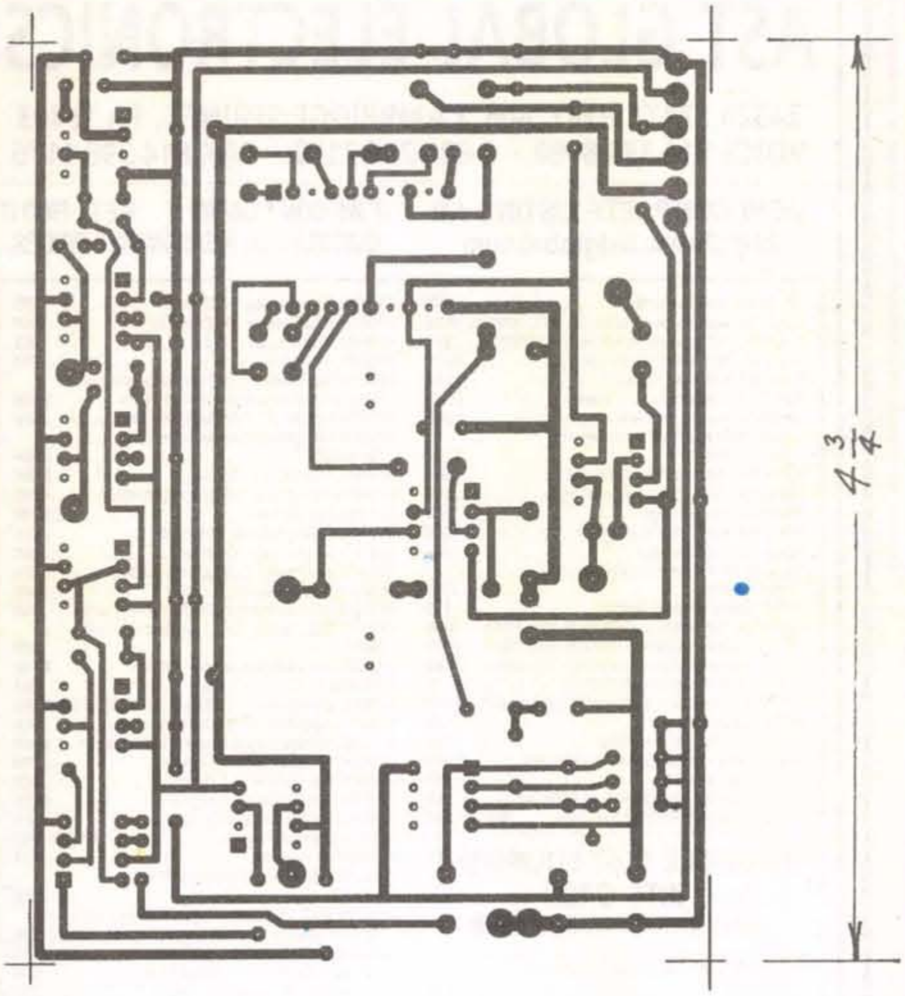
TURN IDLE TEST EQUIPMENT — INTO *CASH* —
CALL OR FAX FOR QUOTATION

HP 436A, Power Meter, Opt. 002/009/022 w/8481H Sensor/Cable	$1,200
HP 651B, Test Oscillator, 10Hz-10MHz	$125
HP 652B, Test Oscillator, 10Hz-10MHz	$125
HP 654A, Oscillator, 10Hz-10MHz, 90dB Attenuator	$195
HP 1630G, Logic Analyzer w/pods	$575
HP 1651A, Logic Analyzer	$875
HP 3312A, Function Generator, .1Hz-13MHz	$425
HP 3314A, Function Generator, Opt. 001 SPECIAL	$950
HP 3330B, Automatic Synthesizer, 20Hz-13MHz	$295
HP 3400A, True RMS Voltmeter, 10Hz-10MHz, 1mV-300V	$125
HP 3406A, RF Voltmeter, 50uV-3V, 1.2GHz	$200
HP 3455A, DMM 5-1/2 Digit	$250
HP 3456A, DMM 6-1/2 Digit	$525
HP 3466A, DMM 4-1/2 Digit, AC/Battery, 5 Function	$175
HP 3488A, Switch Control	$450
HP 3551A, Portable Transmission Test Set	$550
HP 3575A, Digital Phase Gain Meter 1Hz-13MHz	$500
HP 3580A, Spectrum Analyzer, 5Hz-50KHz, LED Readout	$650
HP 3580A, Spectrum Analyzer, 5Hz-500KHz, Mechanical	$500
HP 3582A, Spectrum Analyzer, .02-25.5KHz	$1,800
HP 3585A, Spectrum Analyzer, 20Hz-40MHz SPECIAL	$2,800
HP 3702B, IF/BB Receiver w/3705 Diff. Phase Detector	$475
HP 3730B, Down Converter Mainframe	$750
HP 3770A, Amplitude/Delay Distortion Analyzer	$300
HP 3779B, Primary MPX Analyzer	$500
HP 3781B, Pattern Generator	$250
HP 4274A/Opt. 001, LCZ Meter SPECIAL	$2,400
HP 4959B, WAN Protocol Analyzer/J2213A	$1,200
HP 4972A, LAN Protocol Analyzer	$750
HP 5314A, Counter, 100MHz, Opt. 002, w/Manual, NICE!	$175
HP 5314A, Counter, 10MHz, Opt. 001 (tcxo), NICE!	$175
HP 5315B, Counter, 100MHz, Opt. 001, w/Manual, NICE!	$275
HP 5315B, Counter, 1GHz, Opt. 001/003, w/Manual	$425
HP 5316A, Counter, 100MHz, HPIB	$350
HP 5328A, Counter, 100MHz w/DVM/Opt. 021	$200
HP 5328A, Counter, 500MHz	$250
HP 5334A, Counter, 100MHz, Opt. 010 Oven	$500
HP 5340A, Counter, 18GHz (nixie)	$600
HP 5345A, Counter, 500MHz	$450
HP 5345A, Counter, 500MHz, HP-IB	$650
HP 6101A, Power Supply, 0-20V @ 1A	$125
HP 6104A, Power Supply, 0-20, 20-40V @ 2A, 1A	$150
HP 6112A, Power Supply, 40V @ .5A (metered)	$150
HP 6116A, Power Supply, 0-100V @ 200MA	$150
HP 6177C, DC Current Source to 100V@500MA	$275
HP 6202B, Power Supply, 40V @ .75A (metered)	$150
HP 6203B, Power Supply, 7.5V @ 3A (metered)	$150
HP 6205B, Power Supply (dual), 0-40V @ .3A, 0-20V @ 8A (metered)	$175
HP 6206B, Power Supply, 0-60V @ 1A (metered)	$200
HP 6212A, Power Supply, CV/CC, 0-100V @ 100MA	$125
HP 6213A, Power Supply, CV/CL, 0-10V @ 1A	$75
HP 6217A, Power Supply, CV/CL, 0-50V @ 200MA	$100
HP 6218A, Power Supply, CV/CC, 0-50V @ 200MA	$125
HP 6227B, Dual Tracking PS 0-25V @ 2A	$375
HP 6260B, Power Supply, 10V @ 100A (metered)	$300
HP 6264B, Power Supply, 0-20V @ 20A	$225
HP 6265B, Power Supply, 40V @ 3A (metered)	$200
HP 6266A, Power Supply, 40V @ 6A (metered)	$200
HP 6266B, Power Supply, 0-40V @ 5A	$275
HP 6289A, Power Supply, 0-40V @ 1.5A (metered)	$175
HP 6294A, Power Supply, 0-60V @ 1A (metered) New in box w/manual	$275
HP 8011A, Pulse Generator, .1Hz-20MHz	$175
HP 8013B, Pulse Generator, 1Hz-50MHz	$275
HP 8015A, Pulse Generator, .1Hz-50MHz 30V	$400
HP 8016A, Word Generator, 50MHz	$600
HP 8018A, Serial Data Generator	$750
HP 8091A, Rate Generator (1GHz) w/8092A Delay Generator (1GHz) w/8093A Output Amp w/15401A & 15400A	$1,000
HP 8160A, Programmable Pulse Generator, 50MHz, Opt. 001	$850
HP 8160A, Programmable Pulse Generator, 50MHz, Opt. 001/020	$1,000
HP 8161A, Pulse Generator, 100MHz	$1,500
HP 8165A, Programmable Sig Source, 1milliHz-50MHz	$950
HP 8175A, Data Generator	$1,750
HP 8443A, Tracking Generator, 1KHz-110MHz	$275
HP 8445B, Auto Preselector, 1.8-18GHz	$275
HP 8445B, Auto Preselector, 1.8-18GHz Opt. 002/003	$375
HP 8601A, Sweeper Generator, .1-110MHz	$400
HP 8614A, Signal Generator, 800-2400MHz, AM/FM Leveled	$300
HP 8616A, Signal Generator UHF, 1.8-4.5GHz, +10-126dB, AM/FM	$300
HP 8620C, Frame w/86222B Sweeper .01-2.4GHz	$1,150
HP 86242D, RF Plug-in, 5.9-9.0GHz	$225
HP 8640B, Signal Generator, .5-1050MHz, Opt. 002/001 or 003	$1,800
HP 8640B, Signal Generator, .5-512MHz, Opt 001 or 003	$700
HP 8656A, Synthesized Signal Generator, 100KHz-990MHz	$1,400
HP 8684D, RF Signal Generator, 5.4-18GHz	$1,700
HP 8743A, Reflection Test Set, 2-12.4GHz	$200
HP 8770A, Arbitrary Waveform Synthesizer	$2,400
HP 8901A, Modulation Analyzer Opt. 010	$875
HP 8901A, Modulation Analyzer SPECIAL	$650
HP 59303A, D/A Converter	$125
Kepco ATE15-50M, Power Supply, 0-15V @ 50A (metered)	$500
Krohn-Hite 3202R, Dual Channel Tunable Filter, 20Hz-2MHz, High Pass, Low Pass Band Reject	$200
National Instruments GPIB-100A, Bus Extender	$175
Power Designs 2K-10 HV PS 1-2000V@10MA	$375
Racal Dana 1991, Counter/Timer, 2 Channel	$275
Racal Dana 1992, Counter/Timer, 1GHz	$375
Rockland 1022F, Dual Hi/Lo Filter	$125
Rockland 5100, Synthesizer, DC-2MHz, .001 Hz Resolution	$325
Sencore CM2000, Computer Analyzer SPECIAL	$1,400
Sencore LC102, Capacitor/Inductor Analyzer	$950
Sencore SC61, Scope (100MHz) w/New Probes, Dual Trace	$750
Sencore SC61, Scope (100MHz) w/o Probes, Dual Trace	$400
Sencore TVA92, TV Video Analyzer	$1,100
Sencore VG91, Universal Video Generator	$1,200
Sorenson DCR-80-5A, Power Supply, 80V @ 5A (metered)	$375
Tek 7S14, Plug-in Sampling Plug-in, DC-1GHz	$425
Tek AM501, Plug-in Op Amp	$175
Tek AM502, Plug-in Differential Amp	$225
Tek DC503, Plug-in Counter Universal, 100MHz	$150
Tek DC509, Plug-in Counter, 135MHz, UNUSED	$375
Tek DM502, Plug-in DMM	$125
Tek DM502A, Plug-in DMM	$125
Tek DM502, Plug-in DMM, 4-1/2 Digit	$150
Tek FG504, Plug-in Function Generator, .001-40MHz	$375
Tek PG501, Plug-in Pulse Generator, 5Hz-50MHz	$175
Tek PS501-1, Plug-in Power Supply	$150
Tek PS503A, Plug-in Power Supply Triple	$175
Tek OIG-502, Plug-in Optical Impulse Generator (unused)	$500
Tek T922, Scope (15MHz), Dual Trace, NICE!	$175
Tek TM503, Power Module, 3 Slot	$125
Tek TM504, Power Module, 4 Slot	$150
Tek TM506, Power Module, 6 Slot	$200
Tek TR503, Plug-in Tracking Generator, 100KHz-1.8GHz	$575
Tek 2213, Scope (60MHz), Dual Trace	$375
Tek 2215, Scope (60MHz) Dual Trace	$450
Tek 2235, Scope (100MHz) Dual Trace	$650
Tek 2236, Scope (100MHz) w/Counter/Timer/DMM	$850
Tek 2246, Scope (100MHz) 4-Channel Cursor RO SPECIAL	$1,200
Tek 2247A, Scope (100MHz) Dual Trace w/ Counter/Timer/Voltmeter SPECIAL	$1,400
Tek 2336, Scope (100MHz) Dual Trace SPECIAL	$525
Tek 2445, Scope (150MHz), 4-Channel Cursor Readout	$1,100
Tek 2445A, Scope (150MHz), 4-Channel Cursor Readout	$1,400
Tek 2465, Scope (300MHz), 4-Channel Cursor Readout	$1,400
Tek 453, Scope (60MHz), Dual Trace	$175
Tek 465, Scope (100MHz), Dual Trace	$425
Tek 465B, Scope (100MHz), Dual Trace	$475
Tek 466, Scope (100MHz storage), Dual Trace	$575
Tek 475, Scope (200MHz), Dual Trace	$475
Tek 475A, Scope (250MHz), Dual Trace	$625
Tek 485, Scope (350MHz), Dual Trace	$700
Tek 520A, NTSC Vectorscope	$400
Tek 576, Curve Tracer SPECIAL	$1,400
Tek 7104, Scope (1GHz), Dual Trace	$1,200
Tek 7104, Scope (1GHz) w/7A29, 7A29, 7B10 & 7B15	$2,200
Tek 7844, Scope (dual beam) w/7A24, 7A26, 7B80 & 7B87	$750
Tek 7904, Scope w/7A24, 7A26, 7B80 & 7B85	$750
Tek 7904A, Scope w/7A24, 7A26, 7B80 & 7B85	$825
Tek 7904A, Scope (500MHz) Frame	$425
Wavetek 145, Pulse/Function Generator, .0001-20MHz	$300
Wavetek 157, Programmable Waveform Synthesizer	$425
Wavetek 1855, CATV Sweep/Transmitter	$750
Wavetek 288, Synthesized Function Generator, 20Hz-20MHz (unused)	$800
Wavetek 442, Dual Hi/Lo Filter, 1Hz-10KHz	$400

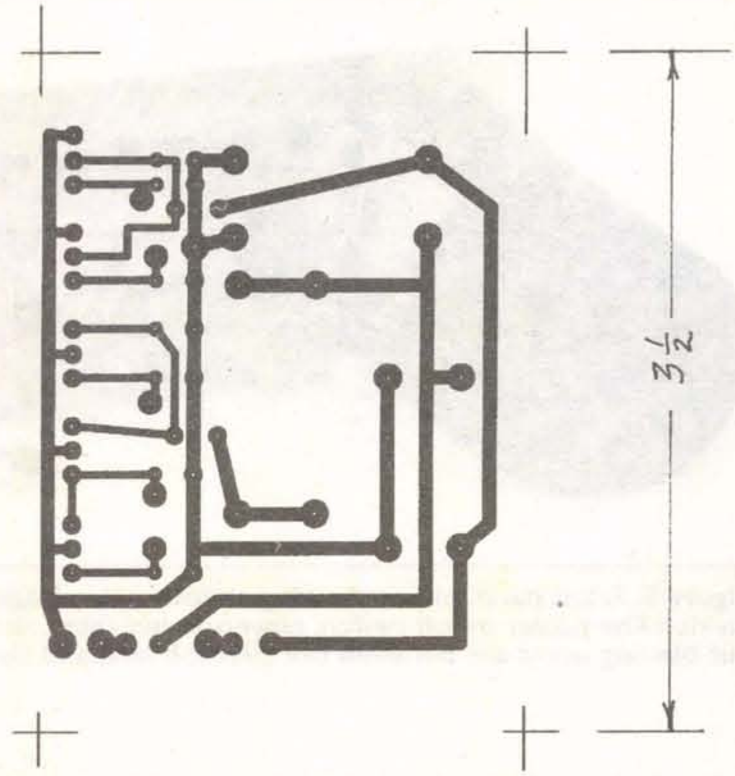
VISA · MasterCard · DISCOVER NOVUS · AMERICAN EXPRESS

- 60-DAY WARRANTY
- 10-DAY RIGHT OF RETURN
- SATISFACTION GUARANTEED

Write in 188 on Reader Service Card.



ARTWORK FOR MAIN BOARD



ARTWORK FOR POWER SUPPLY BOARD

The rear panel is used as a heatsink so the regulators must be positioned so their mounting holes line up with the corresponding panel holes at the same time the two board mounting bracket holes match their panel holes.

Complete the board, clean off the solder flux and inspect it for good solder joints and no bridges. The wire lengths that go to the six-pin DC power connector, P5, aren't critical, but about nine inches seems okay. The wires to the three-pin AC line connector, P6, should be about six inches long.

"Braiding" the AC wires will

HOBBYISTS' ELECTRONIC SURPLUS

New Arrivals Daily!

FREE RESISTORS

We also service small & large OEM accounts.
We buy & sell excess electronic inventory.

(408) 573-7045

Check out our website
www.excess-solutions.com

E$ Excess Solutions
Retail Store Location
430 E. Brokaw Rd.
San Jose, CA 95112

RESOURCE LIST

Possible sources of voltage dividers: **Joseph B. Cohen**, 200 Woodside Ave., Winthrop, MA 02152; 617-846-6312. **Psitech Plus**, 531 Gordon Court #A, Benicia, CA 94510; 707-745-4804. **Tech-Systems**, 1309 Highway 71, Belmar, NJ 07719; 1-800-435-1516.

New voltage dividers are available from **IET Labs, Inc.**, 534 Main Street, Westbury, NY 11590. 1-800-899-8438 (and others).

The cabinet shown in the photos is a type MC-9A. It is available from: **SESCOM, Inc.**, 2100 Ward Drive, Henderson, NV 89015-4249; 1-800-634-3457.

The recommended five-volt DC reference (and the SWR300) are available from: **Thaler Corporation**, 2015 N. Forbes Blvd., Tucson, AZ 85745; 1-800-827-6006.

PC board artwork, panel drilling drawings, and front panel artwork for both the internal and external divider models can be downloaded from our web site at http://www.zianet.com/tdl. Click on Magazine Article Reprints, then click on "model305.zip" to download. After you unzip the file, read "contents.txt" for an explanation of the other files. The power transformer and single-lug terminal are available (limited quantity) for $7.00 postpaid in the US from: **TDL Technology, Inc.**, 5260 Cochise Trail, Las Cruces, NM 88012-9736; 505-382-3173, FAX 505-382-8810; E-Mail: Rtipton@zianet.com.

The MAX319CPA CMOS switch is available from: **Digi-Key Corporation**, 701 Brooks Ave. South, Thief River Falls, MN 56701; 1-800-344-4539.

0.1% and 1% metal film resistors are available from: **Mouser Electronics**, 958 N. Main, Mansfield, TX 76063-4827; 1-800-346-6873.

Write in 189 on Reader Service Card.

help reduce line voltage pickup by the reference circuitry. And remember to use the female three-pin connector here for safety!

When this board is complete, place a small amount of heatsink compound on the back of each regulator and fasten it to the panel with 4-40 x 3/8 inch machine screws and nuts. If you have used the recommended TO-220F style regulators, you won't need any insulators since the packages are self-insulating.

Attach the board mounting brackets to the panel with 4-40 hardware and mount the AC input power connector. Place a grounding lug under one of these nuts for safety ground. Mount the power transformer with a pair of 6-32 machine screws and place the single-lug terminal strip under the left-side mounting nut as seen in the rear panel photo. The power transformer isn't critical, but its physical size is if you are going to use an internal voltage divider.

The reference PC board has 11 jumpers identified by "J" on the

PARTS LIST

RESISTORS

All resistors are 1/4 watt, 1%, metal film unless otherwise noted.

R1,R2,R3,R5,R6,R8,R9	10K (matched, see text)
R4	6650 ohms
R7,R10,R18	4990 ohms
R11,R12,R13,R14,R26	10K
R15	4120 ohms, 0.1%, metal film
R16	22.1 ohms, 0.1%, metal film
R17	10K, 0.1%, metal film
R19	499 ohms
R20,R21	5100 ohms
R22,R23,R24	100K
R25	20 Megohms, 1/4 watt, 5%, carbon film
R27,R28	4700 ohms, 2 watts, 5%, carbon film
R29,R30	82 ohms, 2 watts, 5%, carbon film

CAPACITORS

C1,C2,C14,C15	1 uF, 25 volts, dipped tantalum electrolytic
C3,C4,C5	0.01 uF, 5%, metalized film
C6	0.22 uF, 5%, metalized film
C7	0.022 uF, 5%, metalized film
C8,C9	1000 uF, 50 volts, radial electrolytic
C10	0.22 uF, 35 volts, dipped tantalum electrolytic
C11,C12,C13	0.01 uF, 50 volts, mono-ceramic
C16 through C27	0.1 uF, 50 volts, mono-ceramic

SEMICONDUCTORS

IC1	+5 volt DC reference, see text and Table
IC2,IC3,IC4, IC5,IC9,IC11	OP-07 opamp
IC6	SPDT CMOS switch, Maxim MAX319CPA or equal
IC7	LM310 voltage follower
IC8	Thaler SWR300 precision oscillator
IC10	LM393 comparator
IC12	7818 +18 volt regulator (TO-220F package recommended for all regulators)
IC13	7815 +15 volt regulator
IC14	7805 +5 volt regulator
IC15	7918 -18 volt regulator
IC16	7915 -15 volt regulator
D1	1N4148 silicon diode
D2,D3	1N4003 rectifier diode

OTHER COMPONENTS

S1	Single-pole, three-position rotary switch, break before make, see text
S2	SPST toggle switch rated for 115 volts AC
T1	Power transformer, 115 VAC primary, 36 volts CT, 500 mA secondary
J1,J3	Binding post, red
J2,J4	Binding post, black
J5	Six-pin straight male header, 0.156" pin spacing (Molex 26-48-1061 or equal)
P5	Six-pin female connector (Molex 09-50-3061 housing with 08-50-0134 pins, or equal)
J6	Three-pin straight male header, 0.156" pin spacing (Molex 26-48-1031 or equal)
P6	Three-pin female connector (Molex 09-50-3031 housing with 08-50-0134 pins, or equal)

MISCELLANEOUS

Cabinet, AC input power receptacle with fuse, AC line cord, AC power-on indicator, knob, PC boards, wire, and hardware.

ELECTRONIC TEST EQUIPMENT BOUGHT & SOLD

30 DAY WARRANTY PARTS & LABOR • 10 DAY RIGHT OF RETURN, OPEN ACCOUNTS

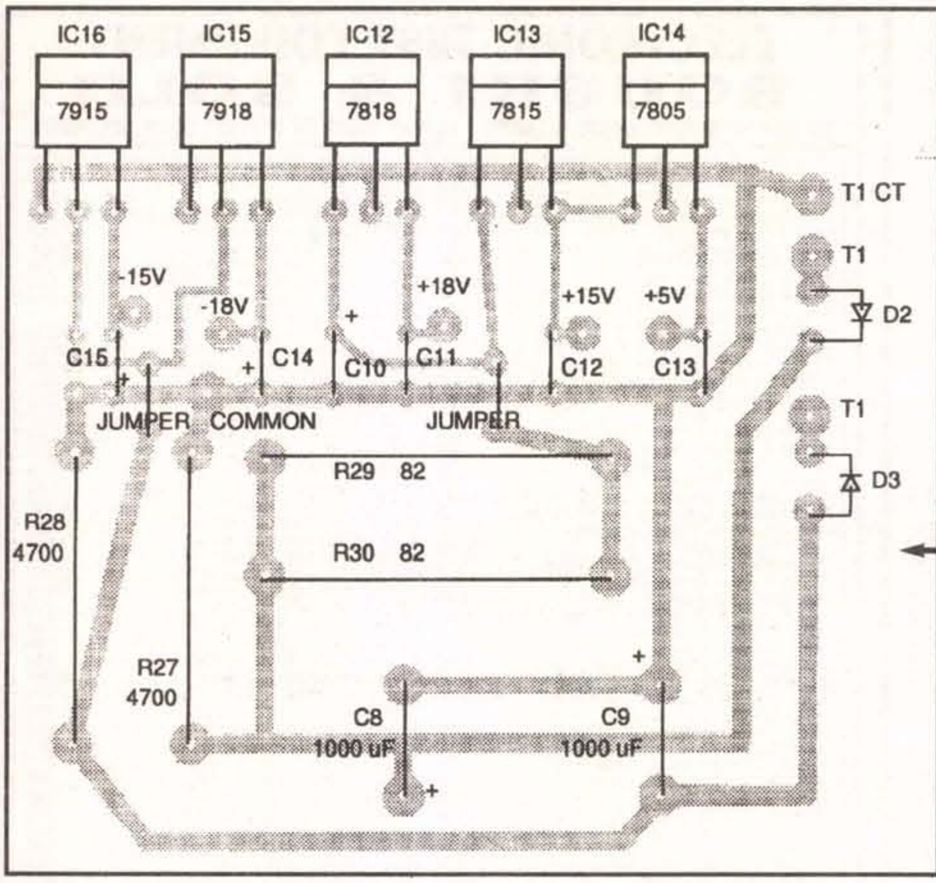
Ailtech Type 32, Precision Attenuator, 0-100dB ... $300
Ailtech 707-90, Comb Generator, 100MHz, 1 Watt ... $250
Argosystems AS210, Frequency Calibration System ... $2,000
Bird 4381, RF Power Analyst, Opt. 832 ... $200
Boonton 82AD, Modulation Meter ... $450
Boonton 92BD, Digital RF Millivolt Meter ... $250
Boonton 2500, DC Range Calibrator ... $250
Boonton 4G, Power Meter Sensor, .01-26.5GHz ... $200
Boonton 4300, Power Meter, 2 Channel ... $800
Bruel & Kjaer 1612, Bandpass Filter ... $250
Eaton 380K11, Frequency Synthesizer, 1-2000MHz ... $1,500
EIP 371, Source Locking Microwave Counter, 18GHz ... $1,000
EIP 578, Source Locking Microwave Counter, 26.5GHz ... $2,200
EIP 931, Microwave Source, .01-18.6GHz, Opt. 9320 ... $3,000
ESI 296, Auto LCR Meter ... $800
Fluke 2205A, Switch Controller/Scanner ... $350
Fluke 515A, Portable Calibrator ... $800
Fluke 5101B, Calibrator Opt. 03,05 ... $2,000
Fluke 540B, Thermal Transfer Standard ... $500
Fluke 5440A, DC Calibrator ... $2,500
Fluke 6010A, Frequency Synthesizer, 10Hz-11MHz ... $300
Fluke 6071A, Synthesized RF Signal Gen. Opt. 130,570,831,870 ... $2,000
Fluke 6080A/AN Frequency Syn., .5-1024MHz ... $3,000
Fluke 720A, Kelvin Voltage Divider ... $800
Fluke 8520A, Digital Multimeter ... $250
Fluke 8840A, Digital Multimeter, 5-1/2 Digits ... $250
Fluke 8922A, True RMSVoltmeter ... $250
Fluke A55, Thermal Converter ... $200
General Microwave 478A, Peak Power Meter ... $700
General Radio 1403G, Standard Capacitor 10pF ... $100
General Radio 1403K, Standard Capacitor 1pF ... $100
General Radio 1409F, Standard Capacitor .001µF ... $100
General Radio 1409L, Standard Capacitor .01µF ... $100
General Radio 1409T, Standard Capacitor .1µF ... $100
General Radio 1409Y, Standard Capacitor 1µF ... $150
General Radio 1557, Vibration Calibrator ... $400
Gertsch RT-7R, Ratio Transformer ... $250
Gigatronics 600/6-12, Frequency Synthesizer ... $1,000
Gigatronics 910, Frequency Synthesizer, .05-26GHz, Opt. 03/06 ... $6,000
Hitachi V-212, Scope, 20MHz, Dual Trace ... $200
HP 1122A, Probe Power Supply ... $200
HP 11590A, Bias Network ... $250
HP 11604A, Universal Extension ... $100
HP 11605A, Flexible Arm ... $100
HP 11638A, Calibration Kit, Type N ... $600
HP 11665B, Modulator ... $250
HP 11869A, Adaptor for Plug-In 8350A/B ... $350
HP 11970A, Harmonic Mixer, 26.5-40GHz ... $600
HP 11970K, Harmonic Mixer, 18-26.5GHz ... $600
HP 11970Q, Harmonic Mixer, 33-50GHz ... $600
HP 1630D, Logic Analyzer w/pods ... $300
HP 1630G, Logic Analyzer, 65 Channels ... $500
HP 16500A, Logic Analyzer System ... $500
HP 16530A/16531A, Digital Scope Card, 16500A System ... $500
HP 214B, Pulse Generator ... $600
HP 33102A, Microwave Switch, 100MHz-18GHz ... $100
HP 3314A, Function Generator, Opt. 001 ... $1,000
HP 3325A, Function Generator ... $800
HP 3325A/01/02, Function Gen., Opt. 01/02 ... $1,200
HP 33322H, Programmable Attenuator, DC-18GHz ... $250
HP 3335A, Synthesized Function Generator 200Hz-81MHz ... $2,000
HP 3336C, Synthesizer, Level Generator ... $1,000
HP 3400A, RMS Voltmeter, 10Hz-10MHz ... $100
HP 3403C, True RMS Voltmeter ... $200
HP 3406A, Frequency Comb Generator ... $250
HP 3456A, Digital Multimeter ... $600
HP 3468B, Digital Multimeter ... $150
HP 35689A, S-Parameter Test Set for 3589A ... $1,400
HP 3575A, Gain/Phase Meter, Opt. 001 ... $600
HP 3582A, Spectrum Analyzer, .02-25.5KHz ... $1,800
HP 3585A, Spectrum Analyzer, 20Hz-40.1MHz ... $3,500
HP 4140B, Picoammeter, DC Source ... $1,500
HP 4191A, Accessories for 4191A ... $400
HP 4274A, Multi-frequency LCR Meter, Opt. 001,002,003 HPIB, includes Test Fixture ... $1,500
HP 435B, Power Meter ... $350
HP 436A/022, Power Meter, HPIB ... $350
HP 467A, Power Amplifier, DC-1MHz, 20 Watts ... $150
HP 5005B, Signature Multimeter ... $200
HP 5006A, Signature Analyzer ... $100
HP 5334A/020, Universal Counter w/DVM ... $600
HP 5335A/010, Frequency Counter ... $600
HP 5335A/030, Frequency Counter, 1300MHz ... $800
HP 5340A, Frequency Counter, 18GHz ... $600
HP 5340A, Frequency Counter w/Opt. 01/02/011 ... $800
HP 5342A, Microwave Counter ... $1,000
HP 5345A, Frequency Counter, Opt. 012 ... $200
HP 5350A/010/002, Microwave Frequency Counter ... $2,000
HP 54100D, Digital Scope, 1GHz ... $1,000
HP 54200A, Digital Storage Scope ... $600
HP 54601A, Digital Scope, 100MHz, 4 Channel ... $800
HP 6002A, Power Supply, 0-50V, 0-10Amps ... $400
HP 6112A, Power Supply, 0-40V, 0.5A ... $200
HP 8015A, Pulse Generator, .1Hz-50MHz, 30V ... $500
HP 8165A, Programmable Signal Source, .0001-50MHz ... $700
HP 8165A, Programmable Signal Source, Opt. 02/03 ... $800
HP 8350A, Sweep Oscillator Mainframe ... $1,000
HP 8350B, Sweep Oscillator Mainframe ... $1,500
HP 83540A, RF Plug-In, 2-8.4GHz ... $1,200
HP 83545A, RF Plug-In, 5.9-12.4GHz ... $1,200
HP 8402A, Power Meter Calibrator ... $150
HP 8410C/8412B, Network Analyzer w/8411A/Opt. 18, 18GHz ... $400
HP 8411A, Frequency Converters ... $250
HP 8414A, Polar Display ... $100
HP 8443A, Tracking Generator ... $200
HP 8444A, Tracking Generator ... $400
HP 8444A/059 Tracking Generator, Opt. 059 ... $700
HP 8445B, Spectrum Anyz., Automatic Pre-Selector ... $300
HP 8447E, Amplifier, .1-1300MHz, Gain 22dB ... $600
HP 8481A, Power Sensor ... $400
HP 8481B, Power Sensor, 10MHz-18GHz, 25 Watts ... $800
HP 8501A, Storage Normalizer, w/cable ... $800
HP 85033C, 3.5mm Calibration Kit ... $1,000
HP 8505A, Network Anyz. w/8501A & 8503A, Opt. 05 ... $3,000
HP 8557A, Spectrum Analyzer, .01-350MHz ... $800
HP 8559A, Spectrum Analyzer, .01-21GHz ... $2,000
HP 8559A/853A, Spectrum Analyzer, Digital, .01-21GHz ... $3,000
HP 8565A, Spectrum Analyzer, .01-22GHz, Opt. 100 ... $2,500
HP 8569A, Spectrum Analyzer, 10MHz-22GHz ... $4,000
HP 8620C/86290A, Sweep Generator, 2-18GHz ... $800
HP 86220A, RF Plug-In, 10-1300MHz ... $500
HP 86241A, RF Plug-In, 3.2-6.5GHz ... $400
HP 86260A, RF Plug-In, 12.4-18GHz ... $400
HP 86290A, RF Plug-In, 2-18GHz ... $800
HP 86290B, RF Plug-In, 2-18GHz ... $1,000
HP 8643A, Synthesized Frequency Generator ... $4,000
HP 8660C, Freq Syn w/86603A & 86635A, 2.6GHz ... $1,500
HP 86601A, RF Plug-In, 110MHz ... $300
HP 86602A, RF Plug-In, 1300MHz ... $500
HP 86603A, RF Plug-In, 2600MHz ... $800
HP 8672A, Frequency Synthesizer, 2-18GHz ... $3,500
HP 8684D, Signal Generator, 5.4-18GHz ... $2,000
HP 8697A, RF Plug-In, 26.5-40GHz ... $250
HP 8743A, Reflection Transmission Test Set ... $200
HP 8743A/018, Reflection Transmission Test Set, 18GHz ... $300
HP 8750A, Storage Normalizer, Includes Cable ... $250
HP 8756A, Scalar Network Analyzer ... $1,500
HP 8901A, Modulation Analyzer ... $600
HP 8901B, Modulation Analyzer, Opt. 001,021 ... $800
HP 8903A, Avon Analyzer, Opt. 001 ... $500
HP 8903B, Audio Analyzer, Opt. 001 ... $1,000
HP E3617A, DC Power Supply, 0-40V, 1A ... $250
HP P486A, Power Sensor, 12.4-18GHz ... $100
HP X486A, Power Sensor, 8.2-12.4GHz ... $100
Keithley 192, Programmable DMM, 6.5 Digits, HPIB ... $600
Keithley 195A, Digital Multimeter ... $300
Keithley 614, Electrometer ... $700
Kikusui PLZ 72W, Electronic Load ... $200
Krohn-Hite 3202, Filter, LP, HP, BP, Unused ... $350
Leeds & North 1091, Capacitor Decade, .001uF-1uF ... $150
Micro Sciences ICT-101, IC Tester ... $300
Ming HT-21, Handy IC Tester ... $100
Narda 5082, High Directivity Bridge, 2-18GHz ... $300
Narda 5292 Directional Coupler, 1-18GHz ... $200
Racal Dana 1515, Delay Pulse Generator ... $500
Racal Dana 1992, Frequency Counter, High Stab. ... $500
Simco A300, Aerostat Anti-static ... $100
Tek 134, Probe Amplifier for P6021 & P6022 ... $100
Tek 1502, TDR with Battery Pack ... $1,000
Tek 1503/01/05, TDR, Scale in Meters ... $1,000
Tek 178, Linear IC Test Fixture, For 577 ... $150
Tek 2245A, Scope, 100MHz, 4 Channels ... $800
Tek 2432, Scope, Digital, 300MHz, 4 Channel, HPIB ... $2,000
Tek 2445A, Scope, 150MHz, 4 Channel ... $1,200
Tek 2445B, Scope, 150MHz, 4 Trace, HPIB ... $1,500
Tek 305DMM, Scope, 10MHz, Dual Trace, DMM, battery ... $500
Tek 318, Logic Analyzer w/accessories ... $500
Tek 338, Logic Analyzer ... $400
Tek 464, Scope, 100MHz Dual Trace, Storage ... $400
Tek 492P, Spectrum Analyzer, Opt. 01,02 ... $5,000
Tek 576, Curve Tracer ... $1,800
Tek 577, Curve Tracer w/177 Fixture ... $1,000
Tek 604, XY Monitor ... $100
Tek 7D20, Programmable Digitizer PI ... $600
Tek 7S11, Sampling Unit w/S4 Head, DC-14GHz ... $800
Tek A610, Current Probe, 2-500 Amps ... $200
Tek AFG5101, Programmable Arbitrary/Function Generator ... $1,000
Tek DC503, Universal Counter Timer TM500 ... $100
Tek DC504, Counter/Timer TM500 ... $100
Tek FG501, Function Generator, 1MHz ... $100
Tek FG502, Function Generator, .1Hz-11MHz ... $250
Tek P6021/134, Current Probe w/Amp, 120Hz-60MHz ... $150
Tek P6046, Differential Probe ... $300
Tek P6202A, FET Probe, 500MHz unused ... $300
Tek P6602, Temperature Probe for DM5110, DM511 ... $150
Tek PG506, Scope Cal System w/TG501, SG503, New Style ... $1,500
Tek PG508, Pulse Generator, 50MHz ... $300
Tek PS503A, Dual Power Supply ... $150
Tek SC502, Scope, 15MHz, Dual Trace ... $100
Tek SC504, Oscilloscope, 2 Channel, 80MHz ... $250
Tek SG502, Sig. Gen. 5Hz-50KHz ... $200
Tek TDS410, Digitizing Oscilloscope, 150MHz ... $1,000
Tek TDS410A, Digitizing Scope, 200MHz, Opt. 13,1F ... $2,000
Tek TM5006, Mainframe, HPIB ... $400
Texscan SSG2000, Freq. Syn., 100KHz-2GHz, AM, FM ... $1,800
Ungar 4624, Solder, Desolder Station ... $250
Vu-Data 5110, Semiconductor Tester, In/out Circuit ... $150
Wavetek 115, Function Generator, .0015Hz-1MHz ... $300
Wavetek 130, Function Generator ... $200
Wavetek 178, 50MHz Programmable Waveform Syn. ... $1,000
Wavetek 180, Sweep/Function Generator ... $200
Wavetek 180, Sweep/Function Generator, .1Hz-2MHz ... $300
Wavetek 185, Sweep/Function Gen. .0001-5MHz ... $400
Wavetek 1084, Signal Gen. Sweeper, 3.5-4.5GHz ... $300
Wavetek 1910, XY Monitor, Dual Trace ... $400
Wavetek 452, Filter, Dual Hi/Lo, 1Hz-10KHz ... $450
Wavetek 907, Signal Generator, 7-11GHz ... $600
Wiltron 610D, Sweeper Mainframe ... $250
Wiltron 610D/6247D, Sweeper with 10MHz-18.5GHz Plug-in ... $400
Wiltron 6219D, RF Plug-In, 2-8GHz ... $200
Wiltron 6229D, RF Plug-In, 7.9-18.5GHz ... $300
Wiltron 62FF75, VSWR Bridge, 10-1000MHz ... $150
Wiltron 6NF50, Autotester, 1-1500MHz, for 640 ... $100
Wiltron 7B50, Detector, 1-1500MHz, for 640 ... $100

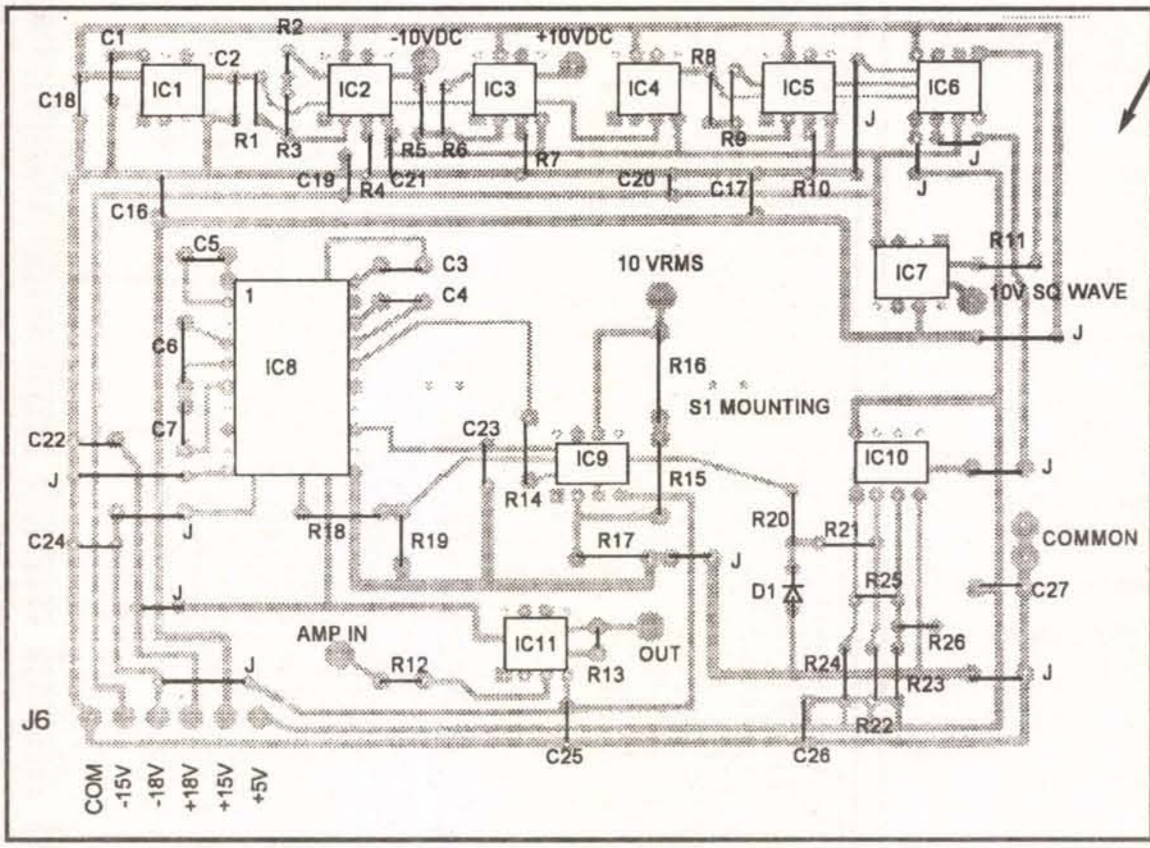
WANTED: YOUR EXCESS TEST EQUIPMENT

Turn your excess test equipment into cash!
Call or Fax your list for a quote.

PHELPS INSTRUMENTS
2631 Hillside Ave., Norco, CA 91760
909-279-7347 • FAX 909-279-7323

MasterCard VISA





parts placement drawing in Figure 8. Place these first, then add the other components using the schematic and parts placement diagrams. I recommend you not use sockets for the ICs as a properly soldered connection has a lower voltage drop and a better temperature coefficient. You will notice this board

Figure 7. Power supply board parts placement. I used brass eyelets in the pads for all off-card connections.

Figure 8. AC-DC voltage reference board parts placement. S1 mounting holes are shown for two different switch widths. Pin 1 of all the ICs is identified by a square pad.

mounts on rotary switch, S1, using the machine screws that hold the switch together (see photo in Figure 6).

The board was designed to fit a standard switch, such as the Electroswitch PA-1000 series. If you use another switch, make sure its mounting arrangement doesn't interfere with any parts on the PC board.

Mount the power on-off switch and the power-on indicator first and wire them according to the schematic diagram (Figure 11). It's a good idea to insulate each connection on the three-pin AC power connector (J6) with a short piece of shrink tubing. Add output binding posts J1 through J4. Then secure the rotary switch with its attached PC board to the front panel with the switch mounting hardware.

Pay attention to keeping the PC board edges parallel to the front panel edges as there's not a lot of clearance between the board and the top and bottom cabinet panels.

If you are using an internal voltage divider, secure it to the panel with its mounting hardware. Next, complete the front panel wiring using the schematic diagrams and photos. Note that IC11 is an opamp connected as a voltage follower with both input and output unconnected on the circuit board. It is used to provide a high impedance load for the voltage divider and a low output impedance for the reference output voltage.

The photos show an internal divider, a 10K ESI Dekapot. If you are using an external divider, you'll want to use the alternate front panel layout that includes two pairs of binding posts to connect to the divider's input and output (see Resources List). The divider's output connects to the input of IC11. And the IC11 output connects to the instrument's output binding post, J1.

Another binding post labeled "CASE" is included on the front panel when an external divider is used. The residual output noise may be lower when the reference and

GET THE FLASHLIGHT OF THE FUTURE!

This Solid-State WHITE LED Mini-Light Gives You Instant Illumination Everywhere You Go.

Super-bright pocket light is compact, durable and produces a high-efficiency beam that can be seen from a mile away. There's no bulb to ever replace. Never be caught alone in the dark again. Hurry - limited quantities available!

HIGH-TECH WHITE LED!

NOW ONLY **$14.00 ea.** + $3 S&H

Perfect for pocket, purse, car, backpack or keychain.

- Replaceable battery included.
- Weight only: 1.1 ounce.
- Compact size: 1.2" x 2.4" x 0.6"
- Made in USA.

LNS TECHNOLOGIES

CALL TO ORDER: 1-831-768-9155
CREDIT CARDS ACCEPTED - NO C.O.D. ORDERS
PO Box 67243, Scotts Valley, CA 95067

Write in 190 on Reader Service Card.

EZ-EP DEVICE PROGRAMMER - $169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds
Portable - Connects to PC Parallel Port
Versatile - Programs 2716-080 plus EE and flash (28, 29) to 32 pins
Inexpensive - Best for less than $200

- Correct implementation of manufacturer specified algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters

EP-PIC (16C5x,61,62x,71,84)	$49.95
EP-PIC64 (16C62-5,72-4)	$39.95
EP-PIC12 (12C50x)	$39.95
EP-PIC17 (17C4x)	$49.95
EP-51 (8751,C51)	$39.95
EP-11E (68HC11 E/A)	$59.95
EP-11D (68HC711D3)	$39.95
EP-16 (16bit EPROMS)	$49.95
EP-Z8 (Z86E02,3,4,6,7,8)	$39.95
EP-SEE2 (93x,24x,25x,85x)	$39.95
EP-750 (87C750,1,2)	$59.95
EP-PEEL (ICT22v10,18v8)	$59.95
EP-1051 (89C1051,2051)	$39.95
EP-PLCC (PLCC EPROMs)	$49.95
EP-SOIC (SOIC EPROMs)	$49.95
EP-TSOP (TSOP EPROMs)	$59.95

Many Other Adapters Available

M²L Electronics
970/259-0555
Fax:970/259-0777
250 CR 218
Durango, CO 81301
CO orders please add 7% sales tax.
http://www.m2l.com

Write in 191 on Reader Service Card.

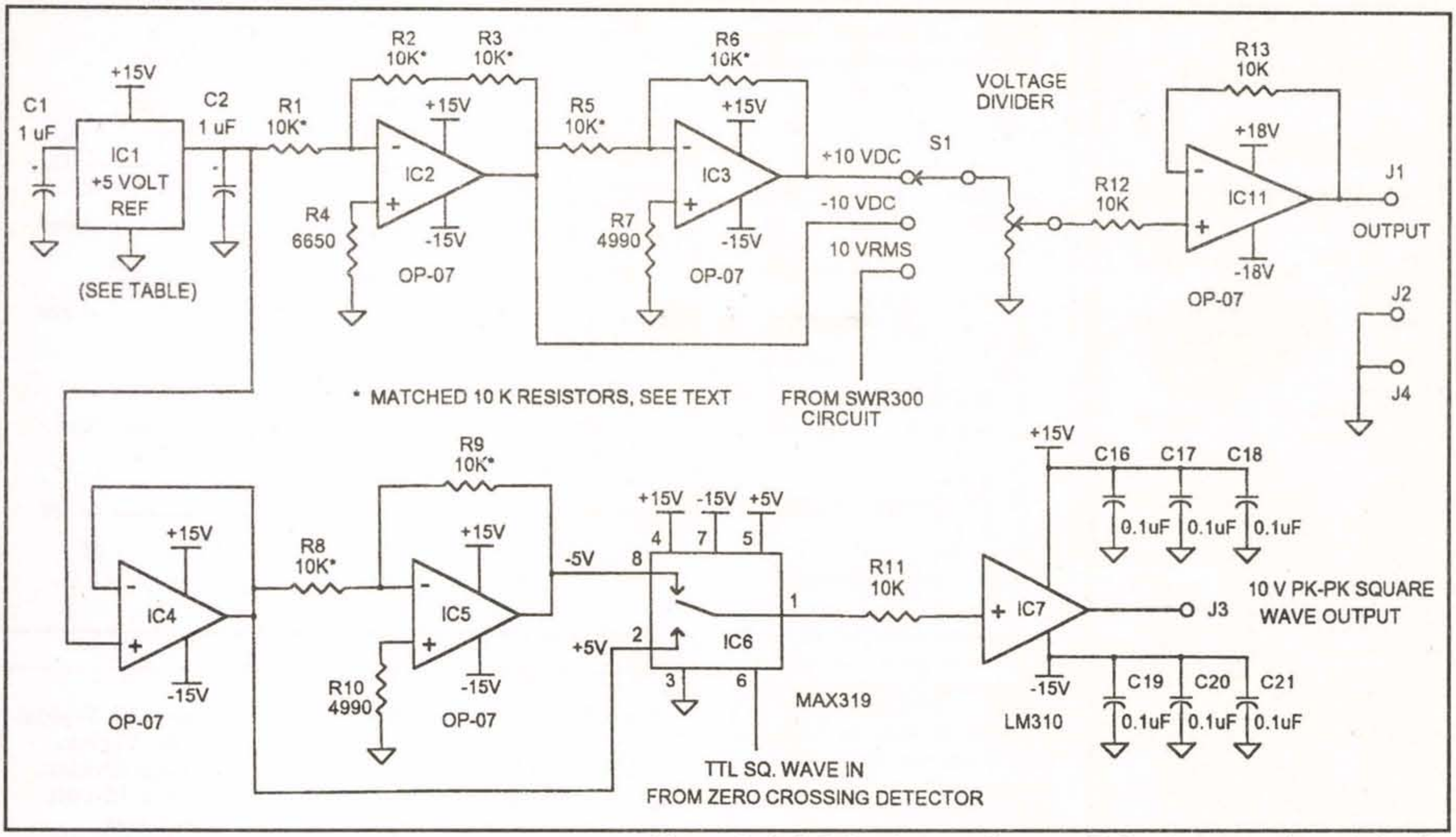


Figure 9. AC-DC voltage reference, DC voltage portion of circuit.

divider cabinets are connected.

When you are satisfied that everything is assembled and wired correctly, plug the two three-pin connectors together, but leave the six-pin DC power plug (P5) unconnected. Make sure there is a fuse in the AC power input connector, attach a line cord, and flip the power on-off switch to on.

Check each DC voltage at the six-pin plug (P5) to make sure they are correct and in the right order. The regulators are rated at ±5% so each voltage should be within this range.

With the power supply working okay, turn off the power and connect the six-pin plug. Now would be a good time to put a dot of red nail polish or other identifier on one end of both pairs of connectors to make reconnection easier. Turn on the power and check for proper operation.

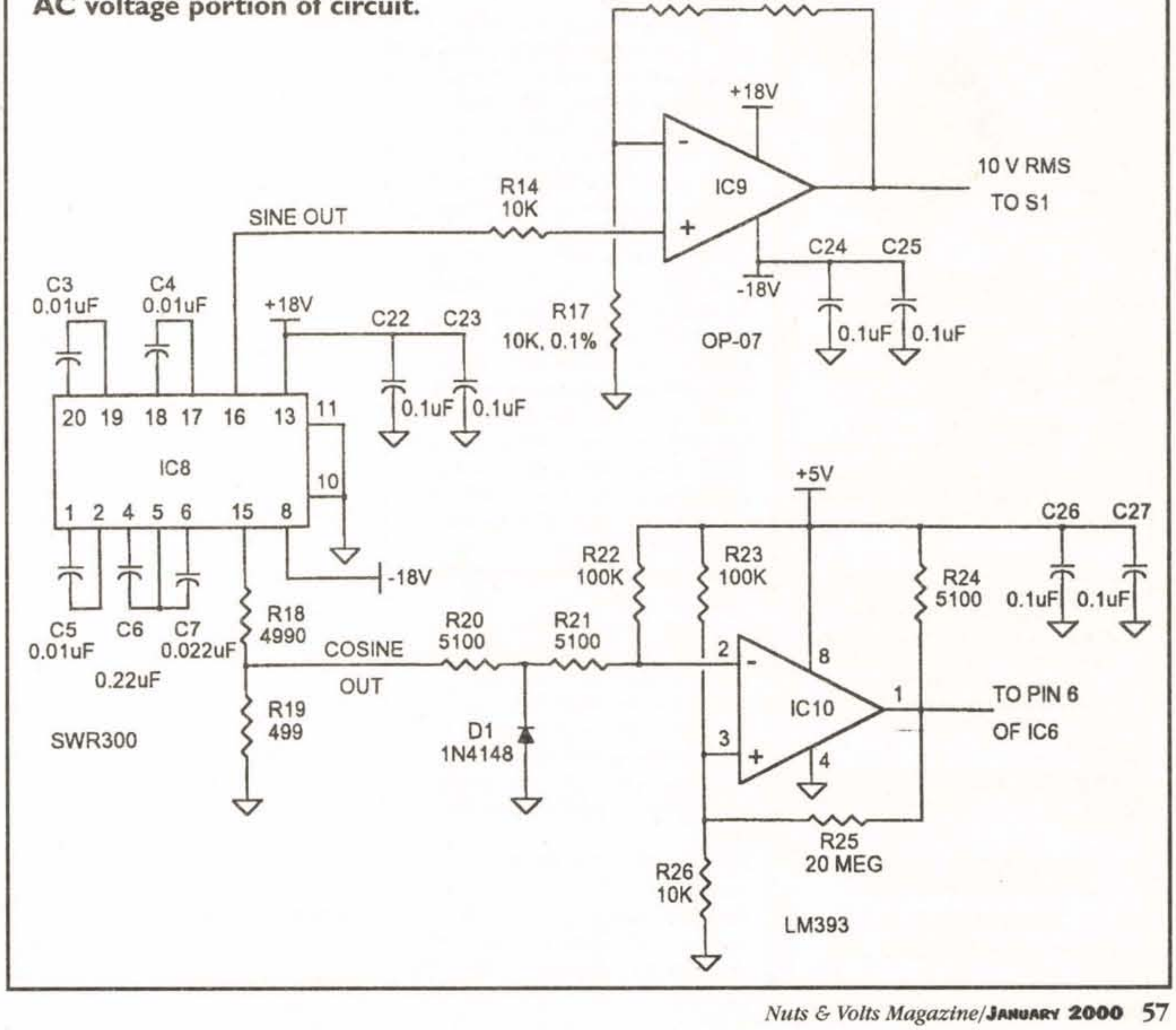
(Tip: You can print the front panel artwork on a sheet of clear laser or inkjet label and stick it to the aluminum after doing the drilling. Although this isn't as durable as silkscreening, it's a whole lot easier!)

VOLTAGE DIVIDERS

Precision voltage dividers are known as Kelvin-Varley dividers. The circuit in Figure 12 shows the ESI Dekapot in which the third decade is a pot instead of a switched set of resistors. However, the principle of operation is the same regardless of model.

Two resistors of the first decade (left-hand side) are shunted by the

Figure 10. AC-DC voltage reference, AC voltage portion of circuit.



D.T.M.F. DECODER

For interconnect and remote control applications

Model NC401

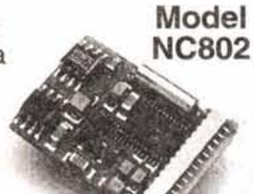
The Model NC401 is a micro-miniature DTMF decoder, designed for selective control of local or remote applications. Measuring .80"Wx1.37"Lx.23"H, the NC401 combines three distinct, multi-addressing decoders offering multiple user-configurable functions. All programmed features are stored in non-volatile E2Prom memory and are easily programmed by means of a conventional DTMF encoder or the Model NC500 Universal/P.C. programmer. This highly engineered decoder is ideal for portable radio applications having limited space for accessories. The NC401 comes complete with micro-miniature 14 pin header and 12" color coded cable assembly.

$59.95

Nor-fax Doc. #5545

VOICE SECURITY ENCRYPTION

Model NC802



The Model NC802 is a miniature inversion scrambler designed to provide intermediate level security for two-way radio voice communication systems and is a perfect, cost-effective solution to entry-level voice scrambling as a defense against unauthorized or casual listeners. The NC802 provides eight user selectable carrier codes commonly used by other manufacturers and interfaces easily to most radios with near transparency to the user.

$59.95

Nor-fax Doc. #5759

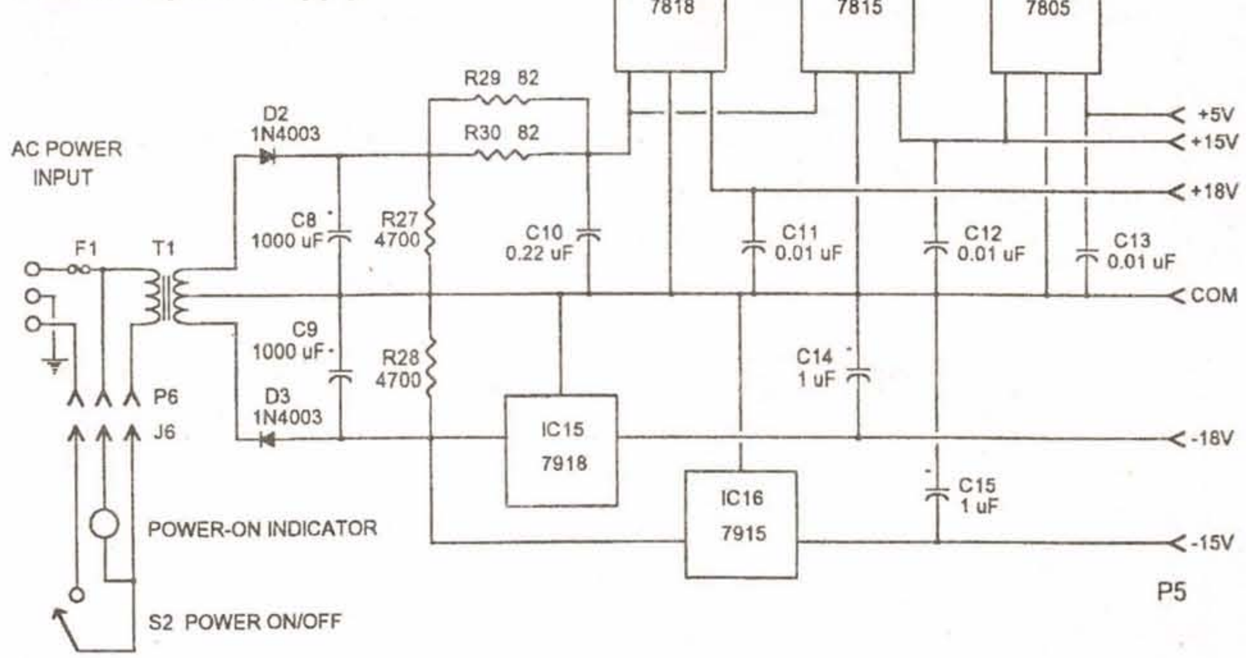
For Detailed Specifications or Product Catalog call our 24-Hour NorFax retrieval system at 530-477-8403 or on our Web Site at www.norcommcorp.com

NORCOMM™ DATA SIGNALLING PRODUCTS

800-874-8663

15385 Carrie Drive
Grass Valley, CA 95949 USA

Figure 11. AC-DC voltage reference, power supply.



whole second decade, whose total series resistance equals the series resistance of the shunted pair in the first decade. Thus, each series resistor in a decade has 1/5 the resistance of the resistors in the previous decade. This circuit presents a constant input impedance and generally has excellent linearity due to the precision resistors used in its construction.

As you can see from Figure 12, the switching is somewhat complicated so this type divider isn't readily built in the average home workshop!

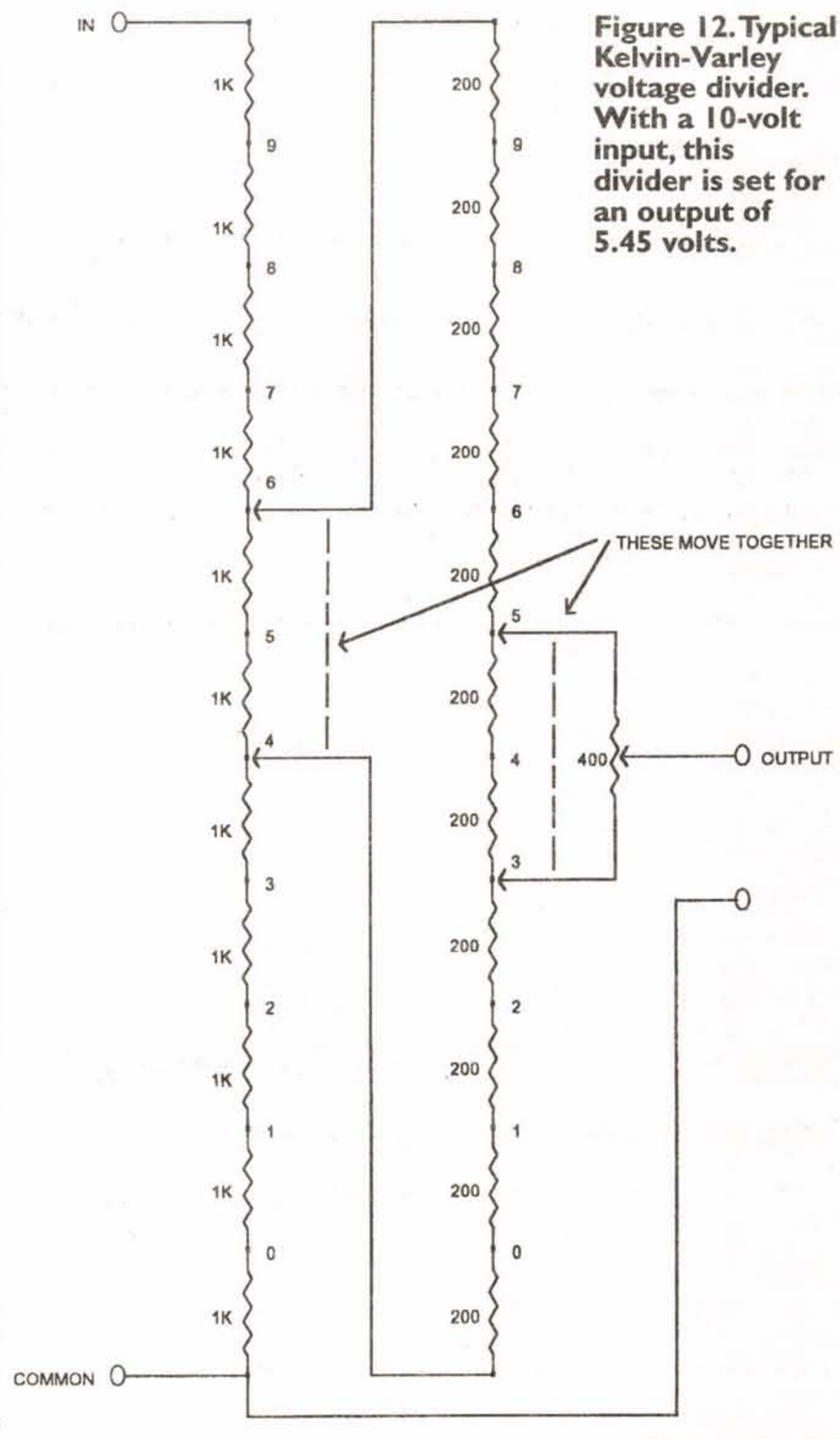
Various models have been built for many years by companies such as General Radio, Electro Scientific Industries (ESI), John Fluke, and others. Since so many have been built, they are fairly common in the "used equipment" market, sometimes at very low cost. "Pre-owned" dividers are often priced at $30.00 to $60.00.

Dividers you may find include ESI models DP211 (shown in the photos), CA1429 Dekapot, RV622, RV622A, and RV724 Dekaviders (Dekapot and Dekaviders are ESI trademarks), also General Radio models 1454A and 1455A and the Fluke model 720A (although its 7-decade resolution is overkill in this application!). Most of these are too large to fit inside the reference's cabinet so they would be used externally.

New dividers are available from companies such as IET Labs, Inc., but even their "economy" models are somewhat pricey. However, I've included their address and phone in the Resources List so you can get data sheets and prices if you are interested.

The ESI line of bridges, dividers and other instruments has been purchased by Tegam, Inc., Geneva, OH. General Radio is now QuadTech, Marlborough, MA. **NV**

Figure 12. Typical Kelvin-Varley voltage divider. With a 10-volt input, this divider is set for an output of 5.45 volts.



Continued from page 42

WANTED: PRO video equipment, VCRs, switchers, cameras, etc. Advanced Media 702-874-1911.

ATV 2.2GHz to 2.7GHz wireless video data link module tuner & transmitter 100mW. Picotronic, web: http://members.aol.com/picotronic/atv.htm

BROADCAST VIDEO equipment wanted: all types, new or old. Please call, Jon with info. 1-800-539-2859.

SONY PLAYSTATION MODCHIPS. Allows playing of CDR backups & imports. $10 + $3 shipping. 619-590-9320.

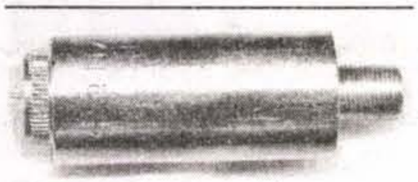
POLICE RADAR JAMMER only $50 + $3.20 S&H with this ad. Phantom brand, Jams X/K/Ka. Order form online. Electronic weapons, EMP, Herf, high voltage, rail/coil/disc guns, plasma, alternative energy, surveillance, etc. Plans and Kits Unlimited, 1839-D West Vista Way #515, Vista, CA 92083. Visit us at: http://www.plans-kits.com or E-Mail: ninteach@plans-kits.com

CABLE TV

GENUINE UNMODIFIED JERROLD DPBB 7312. 410-485-7772. E-MAIL: CLEWIS7298@AOL.COM

DTV & DISH NETWORK INFORMATION (33 pages) only $15. Call toll-free 1-877-856-0923. Plus cable television reference guides for all systems, call 1-877-880-0197.

NEW! CABLE converter electronic service equipment and supplies for most cable converter boxes. Highest service, lowest prices. Call Ken Erny Electronics. 24 hr. order and information hot line 516-389-3536.



NOTCH FILTERS 110, 108.5, 106.5, 97.5 75dB deep notch. $19.95 ea., 1-5 qty. $15.95 ea., 6-10 qty. $11.95 ea., 11-20 qty. $9.95 ea., 21 or more qty. Call 24 hr. order and information hot line 516-389-3536.

DISCOUNT CABLE converters, bullet snoopers, all makes and models: Genuine unmodified General Instrument, Jerrold, Tocom, Scientific Atlanta, Zenith, Pioneer, Panasonic and more. Best warranty. Free catalog 1-800-243-0962.

PC BOARD ASSEMBLY. Thru hole only. Small or large quantities OK. Call Network Sales. 616-683-0500.

CABLE STOP, one stop for all your cable needs, a wide varity of electronic parts & accessories, tools, diagrams, converters, step-by-step instructions, **1-800-280-7830** 12pm-7:30pm EST.

UNMODIFIED CABLE CONVERTERS. Zenith ST1600, ST1086, ST300, Panasonic 175, 145 vol. & non-vol. Regal RR-92 & RC 83, DP5, DP7, DRZ, 5503 VIP, SA 8580. Guaranteed low prices. Please call for more converters 405-631-1856.

CABLE TV. Unmodified converters DP5 $35; DPBB7 $80; 8500 series $15, etc., good prices over 100 pcs. Minimum 10 pcs. any qty., plus all major brands available. Lowest price new/refurbished/field pulls. Phone: 1-800-929-1549.

CABLE CONVERTERS, DBS, remotes, schematics, etc., free flyer. Smart card socket $5 ea. New Atmel 89C52 $10 ea. Jake 419-385-3100.

CABLE CONVERTERS. Original equipment with remote. Like new, ready to go. Lowest prices. Guaranteed. Limited models. Call now 412-833-0773.

CABLE PARTS & EVERYTHING. Best prices & quantity discounts. WE DON'T SELL BOXES. 1-800-MODULE-0.

SONY PLAYSTATION MODCHIPS. Allows playing of CDR backups & imports. $10 + $3 shipping. 619-590-9320.

CABLE TV. Join us on the **INTERNET** to buy and sell cable TV equipment, electronic equipment, DSS equipment, satellite equipment, telephony equipment, and much more. Major equipment dealers and wholesalers online. Auctions, classified ads, discussion forums, chat rooms, and dealer links for all types of equipment. Dealers and vendors call or visit our site for ad rates and links. **WWW.GOCABLETV.COM** or call **1-800-451-0083.**

POSITIVE NOTCH FILTERS. All channels available. Starting at $16 each. Order by single channel #. Top quality non-tunable metal cylinder type. 75dB deep on the notch. Need to block the video on a cable channel? Order a negative notch filter. We carry a large stock on all channels for dealers and vendors. VISA, MASTERCARD, DISCOVER, and UPS COD for established customers. Quantity pricing on 5 or more. 100 pcs. $7 each. Open 8am to 5pm CST, Monday-Friday. All sales must comply with FCC 1996 Cable Act. On the web go to **WWW.GOFILTERS.COM "THE FILTER COMPANY."** Call for all orders **1-800-235-8080.**

NEW GENUINE unmodified Jerrold DP-7113, $50 ea. 1-800-804-8655. E-Mail: CLEWIS7298@AOL.COM

ATTN. DEALERS: New 125 channel VM-3800 converter, $75; Centurion CF-3000 true 99 channel, $55; also RAW Zenith 1600, $65; Pioneer BA-6110, $59. Lowest price guaranteed, minimum 10-lot. 405-692-4982.

INTERNET SECURITY

The latest tricks and methods hackers use on the Net to pirate software (warez), and hack websites. Includes examples, countermeasures, password **defeats**, Packet-Switched Networks, UNIX, Sprintnet, X.25, anonymous FTP, brute force techs, lots of tips. *More!* $29. wrds=29.4K

INTERNET TRACKING & TRACING: Scammers, spammers, stalkers, infectors, and others hide behind the Internet's anonymity to commit serious offenses. Learn from master hackers best methods to track, trace IDs and origins, and to protect your own privacy. *More!* $29. wrds=17.0K

INTERNET FRAUDS DATABOOK: Internet cons, scams and related frauds now rake in $2+Billion annually! Most are done anonymously with impunity. Details how they're done, how to ID them, how to protect yourself. *More!* **$25.** wrds=19.1K

COOKIE TERMINATOR! $25. wrds=8.4K

Any 2 for $49, 3 for $64

ATM SECURITY

100+ ATM crimes, abuses, vulnerabilities, defeats exposed - TEMPEST, mag stripes, false fronts, supercool, *More!* Case histories, labeled internal photos, figures. $39. wrds=41.0K

PBX SECURITY

PBXs hacking losses of $5-$10 Billion/yr! Detailed vulnerabilities (especially for out-dial), countermeasures. Exclusive author interview in Forbes! $24. wrds=17.4K

CELLPHONE/CORDLESS GUIDE

How cellphones operate; mods. Vulnerabilities to hack attack; countermeasures. Cloning details for NAMs, ESNs, etc, control data formats, computing encoded MINs, ESNs, SIDHs, Op Sys, PROMs, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming, step-by-step to keypad-reprogram 100+ popular cellphones. One FREE database search. Plus much on Cordless phones. *More! $49.* wrds=80.0K

PAGER (BEEPER) MANUAL: How Pagers work, different types and uses, freqs, advantages over and uses with cellphones, and tips and tricks. How phreaks hack Pagers; countermeasures. Plus plans for a Personal Pocket Paging System (xmitter and receiver). *More! $29.* wrds=11.7K Both for only $69

THE DIRTY-2 DOZEN!

24+ *Hot* Hack/Phreak Expose' Disks!

See Web **CATALOG NOW!**

COMPUTER SECURITY

Describes in detail how computers penetrate each other, and how **VIRUSES, TROJAN HORSES, WORMS** are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary **FLUSHOT+** protection system. Internet advice, password defeats, glossary - *much more!* **Manual + PC Disk! $39.** wrds=49.5K

THE HACKER FILES: Expose' 3 HD PC disks filled with choice raw, colorful, highly informative hacker, phreaker text files covering many topics! $39.

Both for only $69

BEYOND VAN ECK TEMPEST

Remote eavesdropping plans of TV video "noise" signals. Range up to 1 KM. Describes how van Eck systems work, and are also used in surveillance of computer systems. Plus TVRO vs phone privacy detailed! $29. wrds =14.9K. Van Eck Demo Tape is $29. (15 min). Both for only $49!

CALLER ID & ANI SECURITY

How they work and the many vulnerabilities of Caller ID, ANI, *69, *57, Call Blocking, *67, et al. Describes ESS, SS7, CN/A, CAMA, DNR, Diverters, Centrex! $25. wrds=15.2K

FAX MACHINE SECURITY

All known methods used to hackFaxes and countermeasures. Includes computer fax modems, crimes, interceptions, fax servers, fax-on-demand, protocols, parameters, compression, encryption, and fax surveillance-type mods. *More!* $29. wrds=29.0K

MANY MORE TITLES!

(See Catalog for prices & descriptions)

POWERFUL STOCK SOFTWARE
BEYOND PHONE COLOR BOXES
ANSWER. MACHINE SECURITY
CASINO SECRETS
CHECK & M.O. SECURITY
CREDIT CARD SECURITY
CONS & SCAMS DATABOOK
SOCIAL ENGINEERING
POLYGRAPH SECRETS
BY AN ORDER OF THE MAGNITUDE
ULTIMATE SUCCESS MANUAL
STEALTH TECHNOLOGY
SIMPLE/CHEAP SECURITY ELEC.
SECRET & SURVIVAL RADIO

POWER METER SECRETS

As reported on "60 MINUTES"! 6th Edition! **Details devices that can slow down (even stop) power meters while loads draw full power - great science projects!** Devices plug into one outlet and normal loads into other outlets. Describes meter creep, overload droop, pole meters, etc. **$29.** wrds=10.4K

SPM THE VIDEO: Now its easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPMEM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM-related manuals! $29. (20 min)

THE I.G. MANUAL: Details external magnetic ways (applied to meters) outlaws use to slow down and stop power meters while drawing full loads. $25. wrds=4.9K

KW-HR METERS: How watt-hour energy meters work, calibration, error modes (many), ANSI Standards, etc. **Demand and Polyphase Meters.** Experimental results to slow, stop power meters by others. $25. wrds=24.2K

Any 2 for $49, 3 for $64, all 4 for $79

VOICE MAIL SECURITY

VMSs are hacked to penetrate PBXs to make outgoing calls, get free VMB usage, secretly read/change/delete messages, control/damage the VMS (or its PBX) itself. Details how they do it, countermeasures. A must for users, sysops, security personnel! $29. wrds=14.2K

THE "GOLDFINGER"
THE "SILKWOOD"
SECRETS OF SOLDERLESS BBs
HIGH VOLTAGE DEVICES
MIND CONTROL
UNDER ATTACK!
RADIONICS MANUAL
HEAL THYSELF!
SECRET & ALTERNATE IDs
CRYPTANALYSIS TECHNIQUES
GOVERNMENT LAND GRAB
ROCKET'S RED GLARE
VORTEX GENERATOR
SURVIVAL GUNS & AMMO
THE ULTIMATE DRIVER
Plus Many More – Order Today!

TOP SECRET **CONSUMERTRONICS** CATALOG $1 WITH ORDER, $3 W/O

2430 Juan Tabo, NE, #259, ABQ, NM 87112
P.O. Box 23097 ABQ, NM 87192
Fax: 505-292-4078 (all hours, orders only) Voice: 505-237-2073 (9-7, M-S)

FREE FULL WEB CATALOG: www.tsc-global.com

Established in 1971 by John Williams, MSEE, former DOD weapons engineer and NIH physicist. Featured on CBS "60 Minutes," Forbes, New York Times. Add $5 total S/H (US, Canada). Postal MO is fastest! VISA, MC OK. No CODs. 10% OFF all Orders over $100; $2.00 OFF all New Orders over $20 placed by Mail or Fax. wrds=Estimated Word Count

Sold for legal educational purposes only. Some publications are controversial! We take no responsibility for anything we publish. See Catalog for WARRANTY, SPECIAL PROJECTS and all other applicable policies.

SPECIAL PROJECTS

We will design & build YOU just about anything electronic! All hardware done as **SPECIAL PROJECTS.** Send #10 SASE for SP Application Form, else get at: .../spaf-spp.html

ELECTRONIC TEST EQUIPMENT?

www.levylatham.com

Private Marketers of U.S. Military Surplus Assets

Write in 78 on Reader Service Card.

When Visiting Disney World And Sea World...
Come To The World Of Electronic Surplus!

SKYCRAFT

PARTS & SURPLUS, INC.
ORLANDO, FLORIDA

Located At The Intersection Of I-4 And Fairbanks Avenue.

Self-Service Retail Outlet Featuring Commercial And Government Electronic Surplus Including:

- ★ WIRE
- ★ SWITCHES
- ★ RESISTORS
- ★ TRANSISTORS
- ★ TRANSFORMERS
- ★ TEST EQUIPMENT
- ★ NI-CAD BATTERIES
- ★ COAX
- ★ RELAYS
- ★ HARDWARE
- ★ CAPACITORS
- ★ PANEL METERS
- ★ CIRCUIT BOARDS
- ★ INTEGRATED CIRCUITS

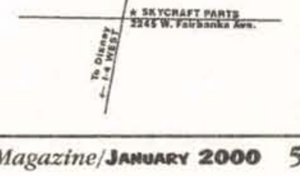
★ ★ ★ ★ ★ ★ ★ ★ ★

We Buy Surplus Electronic Parts —
FAX your list.

www.skycraftsurplus.com

FAX 407/647-4831
PH 407/628-5634
P.O. BOX 536186
ORLANDO, FLA. 32853-6186

HOURS:
Monday - Friday 8:30-6:00
Saturday 8:30-5:00



Write in 79 on Reader Service Card.

GENUINE UNMODIFIED JERROLD DPBB7312 FOR SALE 10 LOT MIN. CALL 708-715-6118.

CABLE PARTS for all makes and models, raw boxes at low prices. Call 1-888-817-8100 www.chipplace.com

WANTED: GENUINE RAW UNMODIFIED CABLE TV CONVERTERS. TOP CASH PAID. CALL 708-715-6118.

PICS, GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.

ALL YOUR cable needs, wholesale prices. All makes and models, dealers welcome. Call now 1-877-449-3737. Fast service Mon-Fri 9:00-5:00 EST. 24 hour msg. 30-day guarantee.

UNMODIFIED JERROLD DPV-5 CONVERTERS, $25 ea. 10 lot min. Call 651-426-4435.

TELEPHONE/FAX

PHONE SYSTEMS WANTED!!! We buy AT&T MERLIN, SYSTEM 25/75/85 and other AT&T phone systems. Please call for a quote or fax us your equipment list. **KEYWAYS, INC.**, 937-847-2300 or FAX 937-847-2350.

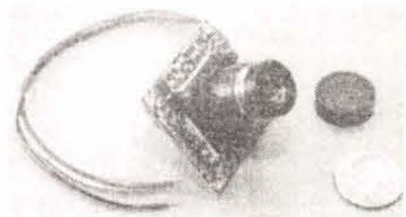
CABLE TV. Join us on the **INTERNET** to buy and sell cable TV equipment, electronic equipment, DSS equipment, satellite equipment, telephony equipment, and much more. Major equipment dealers and wholesalers online. Auctions, classified ads, discussion forums, chat rooms, and dealer links for all types of equipment. Dealers and vendors call or visit our site for ad rates and links. **WWW.GOCABLETV.COM** or call **1-800-451-0083.**

COMPONENTS

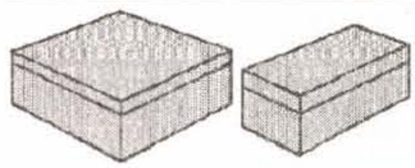
WANT TO Buy: ICs, military & aircraft relays, diodes, transistors, Cannon, TRW, Amp, Burndy, Deutsch, Bendix connectors, electronic test equipment & most components. Hoffy Electronic Ent., 818-718-1165, FAX 818-341-5506. E-Mail: Hoffie1165@aol.com

AMAZING! 35¢ TOGGLE SWITCHES. Brand new. Rated 6amp/125V. Hardware included. 1/4" panel hole. SPDT or DPDT on-on or on-off-on. Minimum 100pcs./package. Visa or MC, no COD. Gateway Products Corporation, 1-800-830-9195. E-Mail: GtwyPrds@aol.com

SEE OUR ad on 4-channel 2.4GHz wireless system in the AdMart section on page 86. Matco, Inc.



B/W 430 LINE CCD CAMERA with optional black low-profile swivel adjustable enclosure. Pin hole or Std. lens type. 6, 8, and 12mm lens are available. 1/3" CCD, 3.6mm/F2.0 lens included; 9-14 VDC, 0.08 lux, IR sensitive; 1.27" x 1.27" x 0.5"D pinhole or 1" deep standard. Price @ 10 pcs., **$44 each**. Enclosure: $8; optional lens: $18. Dealers welcome. MATCO, Inc. 1-800-719-9605. Fax 847-619-0852. E-Mail: sales@mat-co.com Website: www.mat-co.com



POCKET MINI-BOXES: Small plastic boxes. High quality, LOW COST! Low as $0.49. Attention manufacturers! Great for products! 805-339-0702. **www.ElectronicsUSA.com**

GLASS KLEIN BOTTLES, $25 to $40. One sided, zero volume, boundary free, Pyrex manifolds. Acme Klein Bottle, 6270 Colby, Oakland, CA 94618. www.kleinbottle.com

ICs FOR EXPERIMENTERS: Elm offers a variety of ICs for home security, infrared, Control L, as well as basic timing, switch debouncing, etc. Secure purchasing on the web at **www.elmelectronics.com**

CASH PAID FOR ICs. Military or commercial integrated circuits, transistors, diodes, any semiconductors. **ELECTRONIC SURPLUS, INC.,** 5363 Broadway, Cleveland, OH 44127. 216-441-8500 or fax 216-441-8503, since 1946. www.electronicsurplus.com

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

MICROCONTROLLERS

ATMEL MICROCONTROLLER board with integrated programmer. http://www.telusplanet.net/public/brianps/

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

ATMEL 89CXXXX programmer, IBM parallel port, C++ source code, schematics, $250 + S/H. E-Mail: cbanni3061@aol.com

ANTIQUE ELECTRONICS

WESTERN ELECTRIC wanted: 1920s-1960s. Amplifiers, mixers, pre-amps, speakers, tubes, etc. FREE OFFER 1-800-251-5454.

WANTED: FOR historical museum, pre-1980 microcomputers, magazines, and sales literature. Floyd, VA 24091-0341 (540-763-3311/540-382-2935).

CRYSTAL SETS. Parts, plans, books, kits. Largest source in the world. Catalog $2. B. TURKE, PO Box 222288, Hollywood, FL 33022.

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

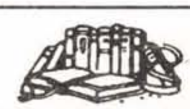
AVIATION ELECTRONICS

BUY, SELL, trade, avionics equipment, Collins, King, Sperry: test equipment, IFR, Litton LTN series INUs. 941-625-3222 P, 941-625-0494 F, E-Mail: avionics@afcon.net

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

PUBLICATIONS

NEW SURVIVAL COMMUNICATIONS BOOK. How to build complete home communications systems. Covers all needs: shortwave radio, amateur radio, citizens band, scanners, federal, weather, alternate news, satellite radio, equipment sources. How to build and use alternate emergency power sources, solar, generators, backup batteries. 200 pages. $24 Fast delivery Priority Mail. MC or Visa. Call Universal Electronics 1-800-241-8171.



OUT-OF-PRINT TECHNICAL BOOKS. www.johnsontechnicalbooks.com 805-525-8955. **sales@johnsontechnicalbooks.com**

www.nutsvolts.com

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.
VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 54501A 100MHZ DIGITIZING SCOPE	$1300.00	HP 4935A TRANS IMPAIRMENT TEST SET	$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	$1000.00	HP 5006A SIGNITURE ANALYZER	$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	$700.00	EIP 575 MICROWAVE COUNTER	$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	$250.00	FLUKE 95 50MHZ SCOPEMETER	$550.00
HP 5370A 100MHZ U.T.I. COUNTER	$400.00	LECROY 7200 400MHZ O-SCOPE	$1000.00
HP 3586C LEVEL METER	$750.00	TEK 475 200MHZ O-SCOPE	$500.00
HP 436A POWER METER W/O SENSOR&CABLE	$500.00	TEK 465 100MHZ O-SCOPE	$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC.ANALYZER	$3500.00
HP 3437A 3 5DIGIT SYSTEM VOLT METER	$250.00	TEK 1240 LOGIC ANALYZER	$750.00
HP 3455A DIGITAL MULTIMETER	$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	$1400.00
HP 3456A DIGITAL MULTIMETER	$400.00	TEK 11401A 500MHZ PROG.0-SCOPE FRAME	$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	$250.00
HP 5335A 200MHZ COUNTER	$600.00	TEK 7A26 200MHZ VERTICAL PLUG	$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	$1000.00	TEK 7B80 400MHZ TIME BASE	$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	$125.00
HP 1740A 100MHZ OSCILLOSCOPE	$250.00	TEK 7S12 SAMPLING PLUG	$250.00
HP 6034A 60VDC-10A POWER SUPPLY	$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	$1000.00
HP 6269B 40VDC-50A POWER SUPPLY	$800.00	TEK AM503 CURRENT PROBE AMPLIFER	$250.00
HP 6553A 40VDC-12.5A. POWER SUPPLY OPT.J01	$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	$400.00
HP 6632A 20VDC-5A POWER SUPPLY	$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT.JO3	$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	$1100.00

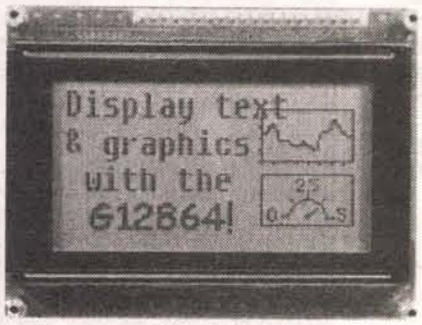
Write in 80 on Reader Service Card.

Serial in, graphics out.
Almost *too* easy.

These serial displays take RS-232 at 2400 or 9600 baud and produce stunning text and graphics on a supertwist LCD screen. See our complete line at www.seetron.com. All models are in stock for immediate delivery.

G12032
120x32-pixel LCD
SGX-120L ***$99.00***
Same size as 2x16 text LCD
Editable font(s) in 4 sizes
Up to 6 screens in EEPROM
Easy terminal protocol

(3.2 x 1.4 in.)



(3.7 x 2.8 in.)

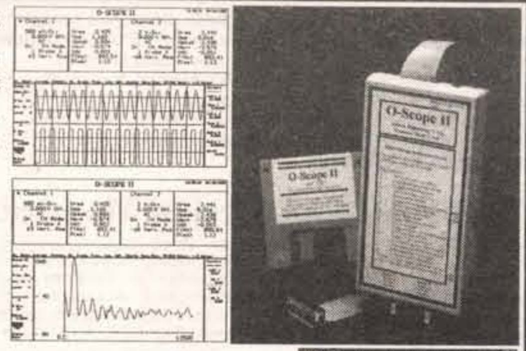
G12864
128x64-pixel LCD
$199.00 BGX-128L-I
Large, sharp LCD
Editable font(s)
Up to 14 screens in flash
Separate text, graphics layers
DB9 connector built in
AC adapter jack built in
Easy terminal protocol

www.seetron.com
Scott Edwards Electronics, Inc. ph 520-459-4802 fx 520-459-0623 nnv@seetron.com

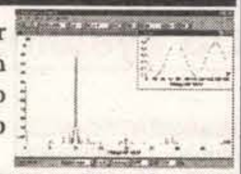
Write in 81 on Reader Service Card.

Digital Storage Oscilloscopes
From $99.00

ATC modules turn your PC into a full-function DSC, spectrum analyzer, logger, & DVM. Units DC to 50MHz. O-Scope II now in Windows 3.1, 95/98, NT and DOS.



O-Scope Ip	**$189.**
O-Scope II	**$349.**
Specialty probes	**call.**



ATC is a stocking distributor for Pico Technology LTD which offers scope modules to 100MSPS, resolutions from 8 to 16 bit.
Pico offers PC based data loggers from 1 to 22 channels, 8 to 16 bit and the Enviromon environmental monitoring system.
Pico products - call

The DFA-5, **low cost differential amplifier,** cuts through common mode noise problems to reveal low voltage signals. With gains from 1X to 1000X and band widths from 20KHz to 1.2MHz, DFA-5 is the test accessory to help you work with signals from 5 Volts to 5 microVoltes. Only $129.00.

NEW DFA5

Serial Port Problems ? ? ?
Check out **Serial ! !** Our lowcost serial channel analyzer only $99.00.

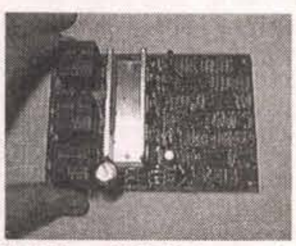
Allison Technology Corporation
2006 Finney Vallet Rd., TX. 77471 U.S.A.
800-980-9806 or 281-239-8500
http://www.atcweb.com atc@accesscomm.net

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

ROBOTICS

ROBOT BOOKS.COM visit our web site for reviews of robotics books, plus robot kits, toys, movies, and magazines! www.robotbooks.com

ARobot KIT from Arrick Robotics uses the BASIC Stamp II. Quality metal construction. Easy to assemble and very expandable. $235. http://www.robotics.com/arobot



H-BRIDGE MOTOR controllers. 12V ($25) and 24V ($35) versions. 35A average, 50A peak PWM out. Many features. Compact. Approximately 3.75" by 5.5". 570-735-5053. http://members.tripod.com/~divelec

ROLLER CHAIN 1/4" riveted single with master link. 10 1/2" $2.50, 5'6" $6.60, 8'3" $9.90. Minimum order $20. Shipping & handling $2.50 for each $20 ordered. Hyatt Electronics, 371 N. Johnson Ave., El Cajon, CA 92020.

PLANS – KITS – SCHEMATICS

PCB Milling

CIRCUIT BOARDS. Low-cost, precision-made PC boards from your CAD program files (no photoplots required). Single and double-sided with contour routing. Ideal for RF/analog/digital prototypes. Full details at http://www.pcbmilling.com E-Mail: feedback@pcbmilling.com FAX: 703-818-0071.

ENCYCLOPEDIA OF electronic surveillance schematics: Schematics with parts identification, $20; **Amateur's guide to wiretapping,** $10. VHS, 1370 Trancas Street, #201, Napa, CA 94558.

TERRIFIC TIMEPIECES! LED binary clock. LED digital clocks, other kits! Free catalog! WPC, 805-339-0702. **www.ElectronicsUSA.com**

QUICK-BUILD PROTOBOARDS. PIC instrumentation chips, kits, telephone electronics, pocket testbench. Oricom Technologies, 303-449-6428. www.sni.net/~oricom

Celebrating our 17th Year Of Service !!

COLLIMATING LENS

This economical collimating lens assembly consists of a black anodized aluminum barrel that acts as a heat sink, and a glass lens with a focal point of 7.5mm. Designed to fit standard 9mm laser diodes. Simply place diode in the lens assembly, adjust beam to desired focus, then set with adhesive.

STOCK#	1-9	10-24	25+
LSLENS Lens Assembly	24.99	23.74	21.37

DIODE/TRANSISTOR TESTER KIT

This dynamic tester allows checking of transistors & diodes in circuit. Identifies NPN or PNP transistors. Checks all types, small or large power. Identifies anode or cathode of diodes.

STOCK#	1-9	10-24	25+
DT100K	24.99	23.74	21.37

ANTI-STATIC FOAM CLEANER

A thick, foaming cleaner for use in static sensitive applications. Safe for plastics and fiberglass. Use on computer cases and all office equipment. Also cleans soft fabrics. 5 oz. aerosol can.

STOCK#	1-9	10-24	25+
SB1102	1.99	1.89	1.70

EPROMS

STOCK#	1-24	25-99	100+
2716	2.99	2.84	2.56
2732	4.49	4.27	3.84
2732A-20	5.49	5.22	4.70
2764-20	5.39	5.12	4.61
2764-25	4.49	4.27	3.84
2764A-20	3.49	3.32	2.99
2764A-25	2.99	2.84	2.56
27C64-15	2.99	2.84	2.56
27256-15	4.79	4.55	4.10
27C256-15	2.99	2.84	2.56
27512-25	3.09	2.94	2.65
27C512-25	2.99	2.84	2.56
27C010-15	2.79	2.65	2.39
27C020-15	3.49	3.32	2.99
27C040-12	5.49	5.22	4.70
27C080-12	10.99	10.44	9.40

Popular I.C.'s

STOCK#	1-24	25-99	100+
7400	.39	.37	.33
74LS00	.19	.18	.16
4017	.29	.28	.25
7805T	.33	.31	.28
7812T	.33	.31	.28
LM317T	.49	.47	.42
LM386N-1	.33	.31	.28
NE555N	.24	.23	.21
LM741N	.24	.23	.21
NE5532N	.55	.52	.47
68HC705C8P	8.99	8.54	7.69
8749	17.99	17.09	15.38
62256LP-10	2.79	2.65	2.39
2816	2.79	2.65	2.39

FM MICROPHONE KIT

Transmit your voice on any FM radio. Range up to 1000'. Case included

STOCK#	1-9	10-24	25+
K30	15.99	15.19	13.67

What Do We Have ?

- I.C.'s
- Oscillators
- Crystals
- Diodes
- Tools
- Laser Diodes
- Vises
- Resistors
- Capacitors
- Connectors
- Trimpots
- Kits
- Vises
- LED's
- Transistors
- And more!

GADGETEER'S GOLDMINE

This exciting collection of electronic projects features experiments ranging from magnetic levitation and lasers to high-tech surveillance and digital communications.

• By Gordon McComb

STOCK#	1-9	10-24	25+
TB3360	24.99	23.74	21.37

• Order Line — (800) 824-3432 • International — (724) 495-1230 • Fax Orders — (724) 495-7882
• Technical Support — (724) 495-1231 • No Minimum Order – (Orders under $20 subject to $ 5 charge) •UPS 3 day, Blue, Red, & Fed. Ex. Shipping Available (Call for charges) • PA Res. Add 7 % Sales Tax •Open Mon-Fri 9:00 AM - 5:00 PM (EST) • Corporate Accounts / Quantity Discounts Available •We accept M/C, VISA, Discover & American Express with no surcharge • Call For FREE Catalog ($2.00 Outside U.S.)
• We Carry A Complete Line Of Electronic Components • Email - unielect @ aol.com

Visit us on the web ! www.unicornelectronics.com

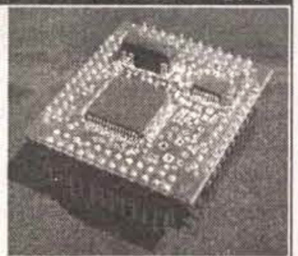
Unicorn Electronics
1142 State Route 18
Aliquippa, PA 15001

FREE SHIPPING!! on pre-paid orders

Write In 82 on Reader Service Card.

UNI-MICRO™

Super-Small - Low Power



The NEW UNI-MICRO series of modules provides a complete ready to use single board computer on a 1.75" X 1.5" module with large amount of non-volatile flash based memory. Expanded capabilities, multiple serial busses, In-circuit programming, including first time programming and a very low power consumption of 58 mA, makes this series of modules perfect for instrumentation, monitoring and control applications.

Microcontroller Design Made Simple

Small • 80C51 code compatible • 256 x 8 ram • 2K x 8 Battery backed sram with automatic power switching • 128K x 8 Flash memory • Parallel or serially programmable • 32K x8 Flash memory • 3 16 bit timers • One 8 channel 10 bit A/D converter • Two 8 bit PWM outputs • One full duplex UART • 16 Mhz speed • 3000 gates flash CPLD • IIC serial bus • JTAG bus • 54 configurable I/O pins • RS232 driver on board • Voltage regulator on board • Power-on reset • Program security • Very low development costs • Asembly, C , Basic programmable.

$59

OS Systems **908-979-1885 http://www.ossystems.net 1464 Route 57th, Port Murray, NJ 07865**

HUDSON ELECTRONICS

ATTENTION DISTRIBUTORS!

Guaranteed Lowest Prices

GENERAL INSTRUMENT • SCIENTIFIC ATLANTA
Genuine, unmodified

★★★ TOP QUALITY EQUIPMENT ★★★

CALL TOLL FREE (877) 449-3737

7 Days • 9 am-11 pm EST

No intention to defraud

Write in 83 on Reader Service Card.

CONSUMERTRONICS 120+ exciting manuals: Electronics, computers, Internet, phones, energy, radionics, financial (including stocks), crime-fighting, security, survival, phenomena, **SPECIAL PROJECTS**. Catalog $3. PO Box 23097, Albuquerque, NM 87192. **www.tsc-global.com**

TEST EQUIPMENT kits. If you liked Heathkit, you will love Technology Systems, 4 Prospect Pl., Torrington, CT 06790.

POLICE RADAR JAMMER only $50 + $3.20 S&H with this ad. Phantom brand, Jams X/K/Ka. Order form online. Electronic weapons, EMP, Herf, high voltage, rail/coil/disc guns, plasma, alternative energy, surveillance, etc. Plans and Kits Unlimited, 1839-D West Vista Way #515, Vista, CA 92083. Visit us at: http://www.plans-kits.com or E-Mail: ninteach@plans-kits.com

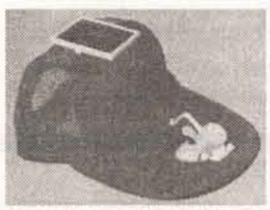
MANUALS – SCHEMATICS WANTED

MISCELLANEOUS ELECTRONICS FOR SALE

POLICE RADAR JAMMER only $50 + $3.20 S&H with this ad. Phantom brand, Jams X/K/Ka. Order form online. Electronic weapons, EMP, Herf, high voltage, rail/coil/disc guns, plasma, alternative energy, surveillance, etc. Plans and Kits Unlimited, 1839-D West Vista Way #515, Vista, CA 92083. Visit us at: http://www.plans-kits.com or E-Mail: ninteach@plans-kits.com

NUCLEAR ELECTRONICS (NIM, CAMAC), PMTs, optics, high vacuum, and high voltage components and equipment. Guaranteed quality at reasonable cost. OE Technologies, Box 703, La Madera, NM 87539. Ph: 505-583-2482, Fax: 505-583-9190, E-Mail: oetech@newmexico.com http://www.oetech.com

PC CABLES: http://www.pccables.com connectors, RS232, IDC, SVHS, ribbon cable, DB9, DB15, loopback, null modem, jumpers, SCSI, screws, rails. Secure online catalog, ordering, browsing. 954-418-0817.



SOLAR-POWERED FAN HAT. Baseball type hat with solar powered fan. Great for sports fans, golfers, etc. Available in red or blue. $19 plus $2.00 shipping. CA residents add 7.75% sales tax. Visa/MC/Disc/Amex OK. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, CA 92670. 714-528-9822, 1-800-377-2023, FAX 714-993-6216.

30KW RF GENERATOR design by Westinghouse WL6426 water cooled tube 50KW, under transmitter conditions. Mike 828-684-7672 HTTP://WWW.CHIGEOR@AOL.COM

HARD-TO-find parts: Big screen screens, $152 & tubes, $135; TV keypads, $15; electronic tuners, $20, US MFD. tubes. Curtis Mathes parts. Call 912-272-6561. Scarborough TV, 1422 Old River Rd., East Dublin, GA 31027.

HIGH QUALITY TOOLS AND STAINLESS STEEL HARDWARE. European and American screwdrivers, nutdrivers, pliers, hex-keys, balldrivers, and more! Wiha, Bondhus, and Knipex. Stainless cap screws, machine screws, nuts, washers, U-bolts, and eyes. Free catalog. Robert Mink Import-Export, Box 6437V, Fair Haven, NJ 07704. Telephone or fax 732-758-8388. E-Mail: w2tv@compuserve.com

ANAHEIM WIRE PRODUCTS. DISTRIBUTOR OF ELECTRICAL WIRE AND CABLE since 1973. Items available from our stock: Hook up wire, Automotive primary wire, GXL, SXL, Plenum cable, Teflon wire, Multi-conductor cable, Irradiated PVC, SO-CORD, Mil-Spec wire, Building wire, Welding cable, Battery cable, Telephone wire, Shrink tubing, Cable ties, Connectors. Wire cut & strip to specs. If interested, please call **1-800-626-7540**, FAX: 714-771-5043. Visa/MC/Amex. SEE US ON THE INTERNET: http://www.anaheimwire.com OR E-Mail: info@anaheimwire.com

FREE FLYER on DBS, cable TV, phones, credit cards, schematics, health items. Bill 1-800-879-9657.

ATTENTION TV-AUDIO SERVICERS! Jobe Electronics has 1,000,000+ OEM parts for sale. 1960s-1990s at below wholesale cost. Call 618-993-6340 for more information. Vintage parts specialists, most brands. TV main board assemblies $10 ea., over 100 in stock! Call 618-993-6340.

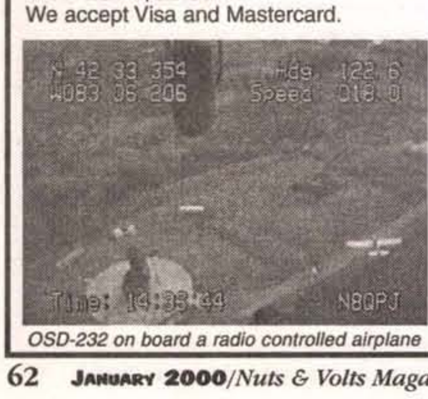
HIGHEND EQUIPMENT 203-744-4111. OK INDUSTRIES DEMO BLOWOUT. If it is not listed just give us a call, chances are we have it! **SOLDER STATIONS**: total rework, forced convection, hot air. MTR5000 (retail $4,595) sell $1,700; MTR4000 (retail $3,995) sell $1,400; MTR3001 (retail $2,495) sell $900; BTR2001 (retail $1,595) sell $500; FCR2001 (retail $1,850) sell $700; BTR1000 (retail $825) sell $300; SMT1160 (retail $995) sell $400; SA2000 (retail $395) sell $140; SA1000 (retail $295) sell $100; SA500 (retail $145) sell $50. **PUR-AIR**: Fume exactors. EP101 (retail $1,695) sell $200; EP051 (retail $595) sell $100. **JEM**: Batch ovens JEM310 (retail $7,995) sell $2,500; JEM210 (retail $4,995) sell $1,000. **PICK & PLACE**: Chip placers, vacuum pencils, fluid dispensers. SMT8501 (retail $4,595) sell $1,500; SMT880 (retail $2,200) sell $500; FD1000 (retail $495) sell $150; VP100 (retail $395) sell $100. **BOARD ETCHER**: SSP-75A (retail $995) sell $300. **ALWAYS BUYING: VIDEO, RADIO, PHONE SYSTEMS, COMPUTERS, STEREO, AND BROADCAST EQUIPMENT.**

ON SCREEN DISPLAY- CHARACTER OVERLAY BOARD

Need to display more text than your LCD module can handle? OSD-232 is the solution! From any RS-232 serial source like a PC or Basic Stamp, display 28 columns by 11 rows of information (308 characters total) directly onto any NTSC or optional PAL baseband (video in) television or VCR. OSD-232 can overlay monochrome text onto an incoming video source or display colored text on a self-generated colored background screen.

OSD-232 $99.00
We accept Visa and Mastercard.

Intuitive Circuits, LLC
2275 Brinston • Troy, MI 48083
(248) 524-1918 • http://www.icircuits.com



OSD-232 on board a radio controlled airplane

An OSD-232 video game programmed in BASIC

FASTER THAN MOTOROLA

Two-way radio jamming equipment 800/900MHz. Stop illegal surveillance. **Pager jammers 900MHz.** Stop pagers from going off during school or church service. **Cellular phone jammers.** Stop cellulars from going off during school or church service. **PCS jamming, PCS phones. Lojack/**teletrack/boomerang. Stop illegal tracing/anti-surveillance.
Cordless phone jammers 49MHz/900MHz • Radar jammers Xband • Nextel jammers • Car alarm jammer • CB radio jammer • Garage door jammer • RC radio jammers • AM/FM radio • HF/VHF/UHF radios • 1/8000MHz jamming equipment.

This equipment is designed for anti-surveillance customers: embassies, schools, churches, governments, law enforcement.

IF YOU DON'T SEE WHAT YOU WANT, WE WILL BUILD IT FOR YOU!!

We sell only to specific organizations or for export. Anyone implying illegal activity will be denied assistance and will be reported to law enforcement.

Jam RF • 954-561-8128 or www.jamrf.com

Write in 84 on Reader Service Card.

SX Debugger+Programmer

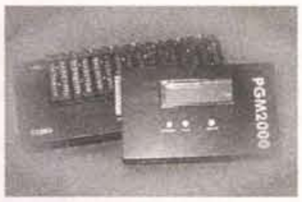
SX-ISD

The ultimate tool for the 100mhz SX microcontrollers - Qualified by Scenix Semiconductor

- In-system debugger for SX18/20/28/48/52
- Built in programmer
- Real-time in-system code execution
- Full speed emulation
- Real-time breakpoint
- Frequency synthesizer from 25khz to 75mhz
- Source level debugging for SASM, SXC
- Selectable internal frequencies
- External break and clock inputs
- Conditional animation break
- Software animation trace
- Parallel port interface
- IDE runs under Win 95/98/NT
- Comes with SASM Assembler, SXDEMO board, SX28AC device and 18-pin, 28-pin SDIP headers

$375

Also Available



PGM2000 Gang Programmer
- Stand alone 8 gang programmer
- Parallel Port Interface for on-line operation
- Different 8-socket program adapters to support DIP, SOIC, SSOP, TQFP, PQFP packages
- Adjustable programming voltages in 0.1V
- Codes and fuse reside securely in EEPROM of Master Control Unit
- Comes with Win 95/98/NT software
- Also supports other processors
- From $900

PGM-SX Programmer
- Parallel Port Interface
- 40-pin ZIF socket to carry device to be programed or program in-circuit
- Comes with Win 95/98/NT software
- Comes with SASM assembler
- Optional SOIC, SSOP, TQFP and PQFP programming sockets
- PGM-SX $149, SMT adapters $120

Advanced TransdAtA CORPORATION
14330 Midway, #128, Dallas, Texas
Tel 972.980.2667 Fax 972.980.2937
Email: atc1@ix.netcom.com

www.adv-transdata.com

Write in 85 on Reader Service Card.

Discover PlanetTest.com... Four new ways to buy, sell or trade— right from your computer!

BID! BUY! SELL!

Bid, Buy, Sell, Save at PlanetTest.com

Discover great prices everyday on new, reconditioned, and used products at PlanetTest.com. Browse through thousands of stand-alone test instruments, tools, accessories and manuals. Plus, you can sell your surplus equipment online.
Join our e-mail newsletter to stay informed of upcoming auctions from leading manufacturers.

The PlanetTest.com Network gives you four instant links to buyers, sellers and outstanding values around the globe.

1) Auction
The largest online test and measurement auction for buyers and sellers—where bids can start as low as $1!

2) Virtual Store
Shop for new, reconditioned, and used equipment direct from the manufacturer, distributor, re-seller, or end-user.

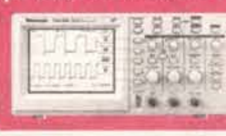
3) Classifieds
Search the Classifieds for a great deal on hard-to-find test instruments, manuals, microwave components, and MORE.

4) Tucker Electronics Store
Over 4,000 new and reconditioned instruments backed by extensive guarantees and warranties.

Here's just a few examples of what you'll find on PlanetTest.com

Direct From B+K Precision
2407A Mini Pro Multimeter
Bids Start @ (Retail Price $55)....... $23
3½-Digit LCD, Max. Reading 3200, AC/DC to 600V and to 10A. Resistance to 30MΩ, diode check, Data Hold and Continuity Test.
MORE INFORMATION ONLINE AT www.PlanetTest.com

Tektronix TDS210 60 MHz, 2-Channel Oscilloscope Bids Start @..... $600
Factory Reconditioned with 3 year Warranty.
MORE INFORMATION ONLINE AT www.PlanetTest.com



Manuals
Prices Start @ $20
Hundreds of Manufacturers and Models to choose from. Over 20,000 online!
MORE INFORMATION ONLINE AT www.PlanetTest.com

Planet Test by TUCKER ELECTRONICS

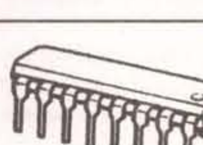
800-527-4642 • www.PlanetTest.com
1717 Reserve Street, Garland, TX 75042 • P. O. Box 551419 • Dallas, Texas 75355-1419

Write in 86 on Reader Service Card.

MISCELLANEOUS ELECTRONICS WANTED

WANTED: TUBE HiFi/commercial amps, preamps, corner/horn speakers. Altec, Marantz, McIntosh, Western Electric, etc. 405-737-3312 fax 405-737-3355.

WANTED: STANCOR/Chicago PCO/PSO-150, PCC-55, PCC-200. Also audio equipment by Langevin or Fairchild. R. Robinson, POB 1425, Wallingford, CT 06492. 203-949-0871. Richmix@erols.com



WANTED: EXCESS ELECTRONIC COMPONENTS, BOARD-LEVEL COMPONENTS; MILITARY COMPONENTS; ICs, MEMORY, TRANSISTORS, DIODES, CAPS, RELAYS, ETC. CALL LPS 562-439-2453 FAX 562-439-0453.

WESTERN ELECTRIC wanted: 1920s-1960s. Amplifiers, mixers, pre-amps, speakers, tubes, etc. FREE OFFER 1-800-251-5454.

WANTED: AVIONICS test equipment, IFR, 600A, 401L, others, Collins, King, Sperry, North Atlantic, Litton INUs LTN series, rate and tilt tables, air data test sets, 941-625-3222 P, 941-625-0494 F, E-Mail: avionics@afcon.net

CASH PAID FOR ICs. Military or commercial integrated circuits, transistors, diodes, any semiconductors. **ELECTRONIC SURPLUS, INC.,** 5363 Broadway, Cleveland, OH 44127. 216-441-8500 or fax 216-441-8503, since 1946. www.electronicsurplus.com

WANTED: TUBES, radios, transmitters, receivers, gyros, bearings, connectors, relays, lamps, synchros. Hyness Company, 709B Delair Road, Cranbury, NJ 08512-4212. Phone: 609-395-1116, FAX 609-395-1117.

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dilog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.,** 937-847-2300 OR fax 937-847-2350.

WANTED: UNITEK WELDING EQUIPMENT. Buying power supplies, welding heads, etc. Call 608-831-3443.

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

BBS & ONLINE SERVICES

INTERNET SECRETS revealed! Download up to $100,000 in Software for free, plus over 30 mind-boggling secrets. **Call 900-820-1221 ext. 4266. In Canada, call 900-830-4700 ext. 8830.** $2.99 per min. Must be 18 yrs. Serv-U 619-645-8434.

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

FREE INTERNET RADIO STATION! Build and broadcast your free online radio station with RockRoll.AM&FM™ http://www.RockRoll.FM Come to the site and download the Destiny Radio Software and let the world hear your stuff. RockRoll.AM&FM™ online radio http://www.RockRoll.FM

BUSINESS OPPORTUNITIES

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

REPAIRS – SERVICES

PICS, GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.

PC BOARDS REPAIRED. Prices start at $5. Minimum 5 of one type. Network Sales, 616-683-0500.

RADIO REPAIR! Reasonable charges. Jim Rupe, 998 Whipple, Grayland, WA 98547-0697. 360-267-4011. E-Mail: w7ddf@yahoo.com

PATENT YOUR HARDWARE/SOFTWARE INVENTIONS. Experienced registered patent agent can help you. Quick, efficient, economical, confidential service. Call 909-599-0801.

CABLE CONVERTER REPAIR: Quality repair service for all name brands. If you're tired of the runaround you're getting from the company you purchased it from, or they're out of business. Give us a call for fast and courteous service, Have model and problem ready. Sorry no box, chip, or IL repairs. **Highview Engineering 815-245-3735** or E-Mail: HIGHENG1@AOL.COM ask for George.

PRINTED CIRCUIT design by professional with 30+ years: conventional, multilayer, downhole, fine line. Prototype and production fabrication. Reverse engineer existing 2-layer board. Toll free 877-236-3223. www.circuit-applied-tech.com

PC BOARD ASSEMBLY. Thru hole only. Small or large quantities OK. Call Network Sales. 616-683-0500.

(E)EPROM PROGRAMMING done quickly and economically. One day turn around typical. Simple copy $3 per device. Also prototyping, design, and consulting services available. Call or send SASE to: **Luzer Electronics, 4023 North Bayberry, Wichita, KS 67226. 316-687-2127, FAX 316-687-3103.**

WELD ALUMINUM WITH PROPANE! EZ, INEXPENSIVE, STRONG. DETAILS: WEEKS, 36 CAROLINA ST., TAYLORS, SC 29687. 1-800-547-WELD(9353) FAX 864-244-6349. http://www.dura-fix.com

MONITOR REPAIR: Flat fee repair, sales, troubleshooting booklets. www.computervision.net

WANTED: MILITARY capacitors, resistors, transistors, diodes, ICs, semi's, etc. Please fax/E-Mail excess lists & RFQs 818-769-1002 fax 818-769-1084. electmatind@earthlink.net & http://www.militarycomponents.com

MAGICIAN IS available to solve your RF problem. INDIVIDUAL RF tutoring, HANDS-ON experience in my LABORATORY with SMT components and LAYOUT up to 3GHz or higher. Emphasize on SiGe, FET, bipolar low noise transistors and ICs where applicable. Minaret Radio, John Horvath ph: 909-421-3983.

Roger's Systems Specialist

24895 Avenue Rockefeller
Valencia California 91355
" We Have Great Connections "
Computer • Telecommunications
Network • Audio • Video

(800)366-0579
(661)295-5577
fax(661)295-8777

Call for Quanity Price breaks!!

www.rogerssystems.com

CAT. 5 CABLE

Also available in many colors!!

Grey

TE-038-L5	3ft. Straight Patch	$1.75
TE-068-L5	7 ft. Straight Patch	$2.00
TE-128-L5	14ft. Straight Patch	$4.00
TE-258-L5	25ft. Straight Patch	$5.00
TE-358-L5	35ft. Straight Patch	$7.00
TE-508-L5	50 ft. Straight Patch	$8.00
TE-758-L5	75ft. Straight Patch	$17.00
TE-108-L5	100 ft. Straight Patch	$16.00

USB CABLES

CC-USB-6	6ft. USB "A"-"A" M/M	$5.00
CC-USB-AB6	6ft. USB "A"-"B" M/M	$5.00
CC-USB-AB10	10ft.USB"A"-"B" M/M	$6.00
CC-USB-AB15	15ft.USB "A"-"B" M/M	$8.00
CC-USB-X6	6ft. USB "A"-"A" M/F	$6.00
CC-USB-X10	10ft. USB "A"-"A" M/F	$6.00

cat.no. CC-USB-PP $25.00
USB to Parallel Printer

USB to SCSI

USB-SCSI-25
USB to DB25 converter cable
USB-SCSI-HD50
USB to HD50 male converter cable
NEW! XpressSCSI $89.00
Preserve your investment in SCSI peripherals. Connect up to seven storge devices to your iMAC, G3 (Blue&White), or USB equipped PC.

$20.00 min. Order required
Add $4.50 shipping for prepaid orders
Prices subject to change without notice
All major credit cards accepted
Special offers only valid on items in stock
Call for quantity discount
No out of state checks accepted

S-VGA Extensions

male/female

CC-VGA-4C	6FT	$6.00
CC-VGA-5C	10FT	$8.00
CC-VGA-25CX	25FT	$16.00
CC-VGA-50CX	50FT	$25.00
CC-VGA-100CX	100FT	$44.00

S-VGA Switch Box Cable

male/male

CC-VGA-3C	6FT	$6.00
CC-VGA-9C	10FT	$8.00
CC-VGA-11C	25FT	$16.00
CC-VGA50MM	50FT	$25.00
CC-VGA100MM	100FT	$44.00

These premium VGA cables are made with 75 ohm coaxial cables. They are triple shielded to support extremely high bandwidth and unsurpassed protection against interference.. Furthermore, our premium cables are Plug-N-Play ready and are compatible with the latest technology.

ADD ON CARDS

Call for more information on any of these cards!!

CA-PPGA-S1	PPGA Celeron CPU Slot 1 adaptor	$10.00
IO-398	ISA 8bit Single Parallel IEEE Card	$12.00
IO-400	PCI 32bit Single Parallel IEEE Card	$33.99
SD-884	16bit ISA Sound Card ESS Chip	$16.00
USB-PCI	USB x PCI Add on Card	$27.00
VD-466	S-VGA SIS 4MB PCI Video Card	$31.00
VD-488	Savage4 32MB AGP 12bit 3D Video Card	$99.00

RIBBON CABLES

CC-333	26"Dual 3.5 Drive Cable	$2.50
CC-344	36" 50Pin 2-device SCSI HDD	$1.00
CC-345-40	48"40pin 5-conn.IDE Cable	$4.00
CC-348	60" 50pin 6-device SCSI HDD	$8.00
CC-354	24" Ultra ATA 80C Dual IDE	$12.00
CC-355 *	SCSI Ultra-2 68Pin T/P Ribbon	$16.00
CC-357 *	50" SCSI Ultra-2 T/P 68 6-device	$29.00
CC-368	36" HD68 SCSI Wide 2-device	$10.00
CC-369	40" HD68 SCSI Wide 4-device	$14.00
CC-370	54" HD68 SCSI Wide 6-devive	$19.00

NEC SPEAKERS

cat.no. TM-179 $15.00
NEC Amp. Speaker Set w/ Cables
Treble and Bass Control

USB MODEM

cat.no. MS-660 $69.00
56K V.90
Download Speed
USB Hot Plug and Play Interface
Distinctive ring for data/fax/voice

SLOT FAN

Extends your computer life.
BallBearing
Takes up only one of the PCI/ISA slots.
Special designed turbine fan gives you great performance and quietness.
$12.00
Cat.no. TM-FAN-SLOT

CPU's-Motherboards-HardDrives
Memory -SCSI Adaptors -SCSI Cables
CD burners -CD's & Rewritable CD's
And Much Much More!!!!!

TECH FORUM

Continued from page 29

ware on your machine. The constraint you really are faced with is the simple reality that you must learn how to access your hardware.

To that end you may want to consult the January '99 issue of this Forum where the answers to question #129815 discussed the PC hardware timer in some detail.

In real physical address mode, the Turbo C "inportb" and "outportb" functions can give you direct access to the I/O space of your machine. If you need blinding speed, you can resort to a C-callable subroutine written in assembler, or you can use assembly language instructions directly in-line with your C language program instructions.

For example, chapter 13 of Tom Swan's *Mastering Turbo Assembler* [ISBN 0-672-48435-8] where he discusses integrating Turbo C with assembly language code.

As discussed in the answers to Forum #129815, the PC clock rates available are given by

clock rate = 1,193,180/preset

where preset is a 16-bit unsigned integer that you get to load into the programmable interval timer (PIT) chip.

For preset=2 you get 596,590 ticks per second, and for preset=3 you get approximately 397,726 ticks per second, so the "450,000" ticks alluded to, in your book on MS C V.6.0, must have been generated by some other hardware. Or, maybe by some of that magic "vaporware" we've heard about.

Jack Dennon
Warrenton, OR

ANS. #2 TO #12997 - DEC. 1999

The simple answer is that a C compiler has little impact on processing speed. A poor C compiler could explain a factor of 2 or 5, but not a factor of 20,000.

An interpreter (instead of a compiler) can be thousands of times slower, but C interpreters are rare (BASIC interpreters were common). The compiler does not limit the rate.

The 18.2 ticks per second is the standard timer interrupt rate. Many programmers have reprogrammed the timer chip to provide a faster rate, but they risk hanging the operating system or breaking other programs.

You could reprogram the timer in Turbo C, but it is poor practice and indicates your hardware is poorly designed.

By your comments, you want to use the peripheral programming model called polling. With polling, the computer periodically checks the peripheral. Polling is simple to program, but it is horrible for high speed events. The problem with polling is low transfer rates and poor latency

Write In 92 on Reader Service Card.

(if the computer is busy doing something else, it may not poll the peripheral in time).

Better performance is achieved with DMA and interrupts. If the transfer rate is low (say less than 1,000 transfers per second), then interrupt transfers will work. Interrupt transfers require the CPU's attention, so each interrupt causes a processor context switch.

These context switches can be expensive (hundreds or thousands of instructions), and that limits the transfer rate. Even though it's a bad idea, many people try to do it.

One hardware designer wanted to do 50,000 interrupts per second. If each interrupt were 1,000 instructions, then the interrupt routine would require 50MIPs — and we still had to run an application.

Furthermore, at the time Microsoft said interrupt latency could be more than 300 microseconds — 15 times longer than the interrupt interval. If the transfer rate is high, then DMA hardware should transfer a block of data and issue an interrupt when the transfer is complete.

Timer interrupts are still important in interrupt and DMA transfers, but they are used for reliability and need not happen often. A typical I/O transfer uses something like the following sequence.

The processor sets up a DMA transfer and tells the peripheral to start transferring data. The processor then does something else (e.g., runs some other task) while the peripheral transfers the data by stealing bus cycles. When the transfer completes, the hardware issues an interrupt, and the processor can work on the transferred data and start a new transfer.

The processor should also keep an eye on each transfer. It should remember when the transfer started, and the processor should check the outstanding transfers periodically (e.g., every timer interrupt). If the transfer does not complete in a reasonable time, then the processor should abort the transfer and reset the peripheral.

If the programmer doesn't include the timeout checks, then the computer will hang waiting for a transfer that never completes.

Gerald Roylance
Mountain View, CA

ANS. #3 TO #12997 - DEC. 1999

The "response speed" for measuring events depends on many factors. Primary ones are:

1. "Raw" system speed.
2. The "language" you use (i.e., C, compiled BASIC, assembly).
3. The speed of the interface bus (i.e., 8 MHz ISA or 33 MHz PCI).
4. The speed of the data acquisition hardware used (ties-in with 3) above).

There are a number of "fixed roadblocks" in the PC architecture that also limit your data acquisition speed: memory refresh interrupts (every five microseconds or so), operating system "overhead" (DOS programs will outstrip Windows-based programs on the same machine any day!), and peripheral interface speeds (again, ties-in with type of interface bus used).

To sum up, here are the primary ways to get the fastest possible data acquisition performance you need:

1. Using a "hot" machine.
2. Using the PCI bus for your acquisition hardware.
3. Writing your applications in Assembly Language and optimizing them for high speed/small size.
4. Running programs under a PURE DOS environment or as "stand-alone" without using any operating system (i.e., embedded "boot-and-go" from floppy).
5. Minimal (or no) use of "standard" magnetic storage (i.e., use a RAM drive).

I suggest browsing the Circuit Cellar web site, **www.circuitcellar.com.** This site is geared towards data acquisition and embedded computing applications.

I know you'll find lots of ideas and information there.

Ken Simmons
Auburn, WA

TROPICAL HAMBOREE ® SPONSORED BY DADE RADIO CLUB OF MIAMI, INC

40th TROPICAL HAMBOREE®
&
ARRL SOUTHEASTERN DIVISION CONVENTION
FEBRUARY 5 - 6, 2000
FAIR EXPO CENTER
S.W. 112 Avenue & Coral Way (S.W. 24th Street) • Miami, Florida
Hours: 9:00 - 5:00 Saturday • 9:00 - 4:00 Sunday
Registration: $5.00 Advance, $7.00 Door

FCC ENFORCEMENT BY RILEY HOLLINGSWORTH, K4ZDH
ARRL FORUM BY LEAGUE OFFICERS, DIRECTORS, SECTION MANAGERS
WASHINGTON SCENE REPORT • AMATEUR RADIO AROUND THE WORLD
FORUMS ON APRS, DX, SATELLITES, GPS
"HANDS-ON" NEW HAM DEMONSTRATIONS AND OPERATING TIPS
DADE COUNTY EMERGENCY RESPONSE TEAM DEMONSTRATION
TWO EXAM SESSIONS FOR ALL AMATEUR LICENSE CLASSES
ALTERNATIVE PROGRAMS ON CRAFTS, HEALTH & BEAUTY
PRIZES & SURPRIZES TO CELEBRATE OUR 40th ANNIVERSARY
MANUFACTURER AND DEALER BOOTHS, 850 SWAP TABLES
300 CAMPSITES ON SITE • FREE PARKING FOR 15,000 VEHICLES

Information on Booths, Tables, Campground & Application Forms
HAMBOREE HOME PAGE: http:..www.hamboree.org
DADE RADIO CLUB HOME PAGE: http://www.daderadioclub.org
Tel: 305-642-4139 or 305-226-5346 • Fax: 305-642-1648 • E-mail: w4wyr@arrl.net or wd4sfg@bellsouth.net

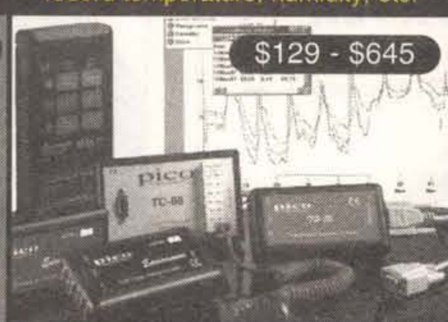
Use your PC as a scope and datalogger!

PC-based Instruments!

Parallel Port Scope
spectrum analyzer, and digital multimeter

ADC Virtual Instruments turn your PC or laptop into a sophisticated storage scope AND spectrum analyzer AND multimeter. Display simultaneously on large screen! 100MS/s 8-bit or 1.2MS/s 12-bit or 333kS/s versions. Great for schools, test depts, etc. Input to Excel! LabView/NT drivers included.

Environmental Logging
record temperature, humidity, etc.



ENVIROMON - temperature (thermistor), humidity & light sensors, door position, etc. Record for 365/24 without a PC even if power fails. Monitor 30 sensors 400 yds away. With cables and easy software. Remote audio alarm. Use **TC-08** for most thermocouples.

osziFOX
20MS/s handheld scope

osziFOX - handheld storage scope and DVM - stand-alone or plugs into your PC for display, store-to-disk, printing in color. Inputs to 100V, trigger, backlit LCD.

Download FREE demo software. Sales only: 1-888-7SAELIG
www.saelig.com 716-425-3753 • -3835 (fax) saelig@aol.com

pico Technology Limited ®

Stocked in NY by Saelig Company: Virtual Instruments, I2C and embedded controllers, BITlink 2-wire networks, RS232/422/485, frame grabbers, etc. See **www.saelig.com** for Product of the Month!

by Joseph J. Carr

Open Channel

Signal Generators — Part I

This month (and next month, too), let's take a look at signal generators. These devices are used to make the signals used in testing and troubleshooting of radio receivers and other circuits, so are of primary interest to almost everyone interested in electronics.

In the pages of this magazine, you will find advertisements for used and new signal generators. You can pick up really sweet signal generators of older style technology for a real song, if you're lucky.

Signal Sources and Signal Generators

Signal generators and signal sources are instruments that generate controlled signals for use in testing and measurement. There is a distinction made by some people between signal sources and signal generators. The former produce continuous wave (CW) output signals without modulation, while the latter will produce one or more forms of modulated signal (AM, FM, SSB, PM) in addition to CW output. In many cases, however, you will see the words "source" and "generator" used interchangeably in popular usage.

Some signal sources produce a single output frequency (or a discrete number of fixed output frequencies). These instruments are sometimes used for testing channelized receiver systems. Other signal sources will produce outputs over a very wide range of frequencies. Add a modulator stage to these instruments and a signal generator is created. Figure 1 shows a typical commercial signal generator.

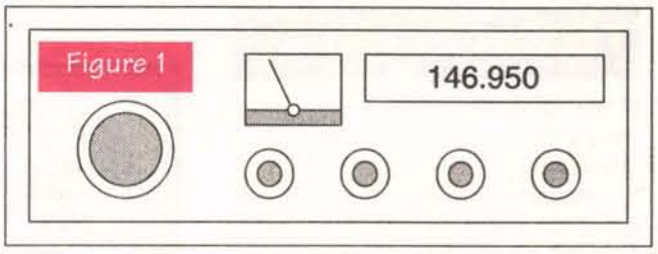


Figure 1

Grades of Instrument

Signal generators and sources come in several grades. Which to select depends on the use. A service grade instrument is used for troubleshooting common broadcast band receivers. They often lack a calibrated or metered output level control, and the frequency accuracy is usually low. More importantly, for many sensitive measurements at low output levels, more signal will escape around the flanges than comes through the output connector. Such instruments are useful for simple troubleshooting, but useless for accurate measurements.

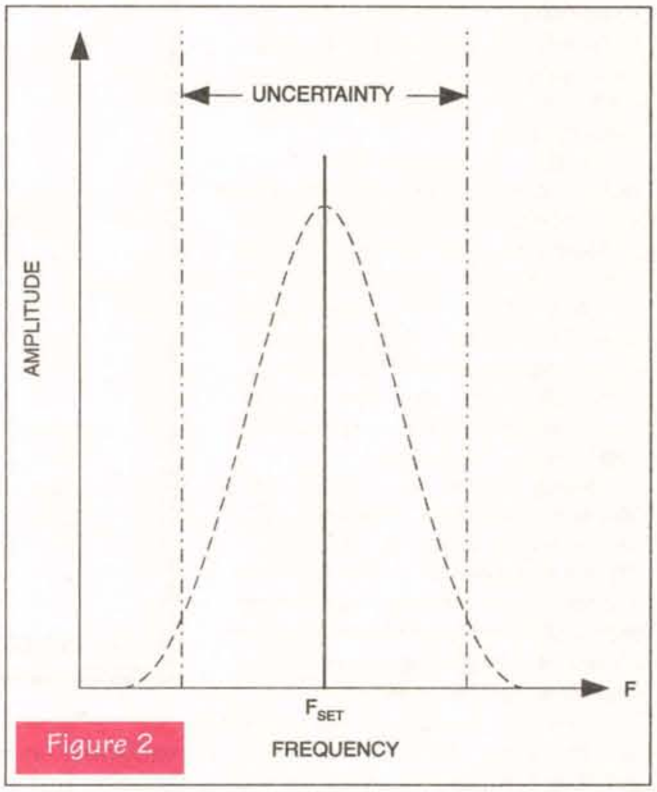


Figure 2

Laboratory grade signal sources and generators are very high quality instruments with accurate frequency readout and output level controls. These instruments are used in making lab measurements of receivers and other devices where high precision and accuracy is desired.

Quality service grade instruments fall somewhere between the two previous grades. Several mainline manufacturers of high quality laboratory signal sources and generators also manufacture "economy" lines that fit this category. They are considerably higher grade than the simple service instruments, but are not up to the lab grade. They are often used for troubleshooting high quality telecommunications and landmobile systems where the highly accurate and precise measurements are not needed.

Output Level

The output of a calibrated signal generator is usually expressed in either microvolts (µV) or dBm (decibels relative to one milliwatt in 50 ohms), or both µV and dBm. It is useful to have a feel for both forms of output level indication. One microvolt (1 µV) is 10^{-6} volts, so when applied across a 50-ohm resistive load, produces a power level of

$$V^2/R = (10^{-6}\ V)^2/(50\ \Omega) = 2 \times 10^{-14} \text{ watts}$$

The 0 dBm reference level is one milliwatt (1-mW) dissipated in a 50-ohm resistive load. This represents an applied voltage of

$$V = \sqrt{PR} = \sqrt{(0.001\,W)(50\,\Omega)} = 0.2236 \text{ volts}$$

If the output level set dial on a particular instrument is not calibrated in the correct units, then the required unit can be calculated using these methods.

To find the output power level in watts or milliwatts from dBm is similarly simple:

$$P = 10^{dBm/10} \text{ milliwatts}$$

TELEPHONE LISTENING DEVICE WITH 12 HR. RECORDER

FCC Approved

Record telephone conversations in your office or home. Starts automatically when phone is answered, records both sides of phone conversation. Recorder stops when phone is hung up. $99.95 + $7 shipping. For telehone listening device separately $19.95 + $2 ship.

For comprehensive 50 page catalog of Micro Video, VHF transmitters, Surveillance, and Counter-surveillance and much more! Send $3.00

Call 407-725-1000

USI CORP

P.O. Box N2052 Melbourne, FL 32902

COD'S OK

BIG POWER LOW COST

Dominos are rugged, miniature encapsulated controllers that com- bine lots of analog and digital I/O with a fast control-oriented floating-point BASIC to provide a one-stop computation and control solution for cost-sensitive control tasks. Used stand alone or connected via RS-232/RS-485, Dominos are true plug-and-go control.

Domino 1 features:
- Full floating-point ROMed BASIC
- 32-KB SRAM and 32-KB EEPROM
- 12 bits of parallel I/O
- 2 PWM outputs
- I²C bus
- 2-channel 12-bit ADC
- Serial port: 19.2-kbps RS-232A, RS-422, or RS-485
- +5 V @ 15 mA

Domino 2 has:
- everything in Domino 1 plus
- 16 more bits of high-current parallel I/O
- Hardware clock/calendar
- Wide-range power operation
- Hardware PWM output

$99 to $139

Visit our Web site for complete datasheets

www.micromint.com

To Order Call: 1-800-635-3355

Micromint, Inc

740 Florida Central Pkwy., Longwood, FL 32750

(407) 262-0066

Write In 29 on Reader Service Card.

Write In 30 on Reader Service Card.

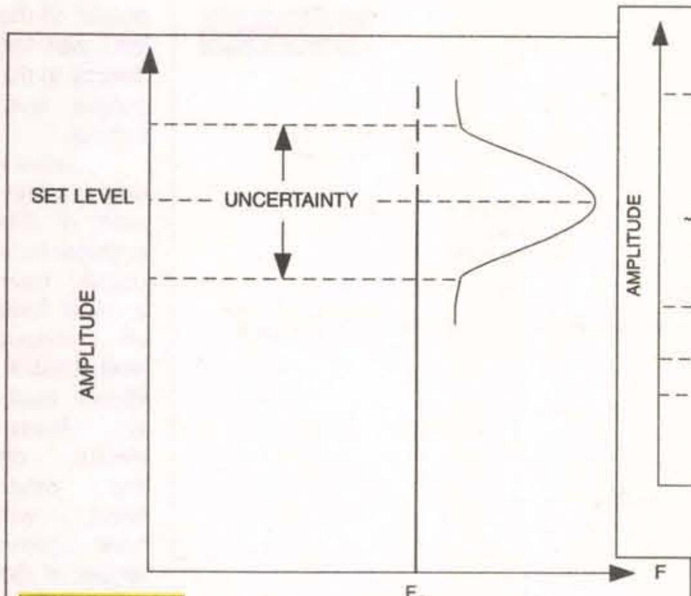


Figure 3

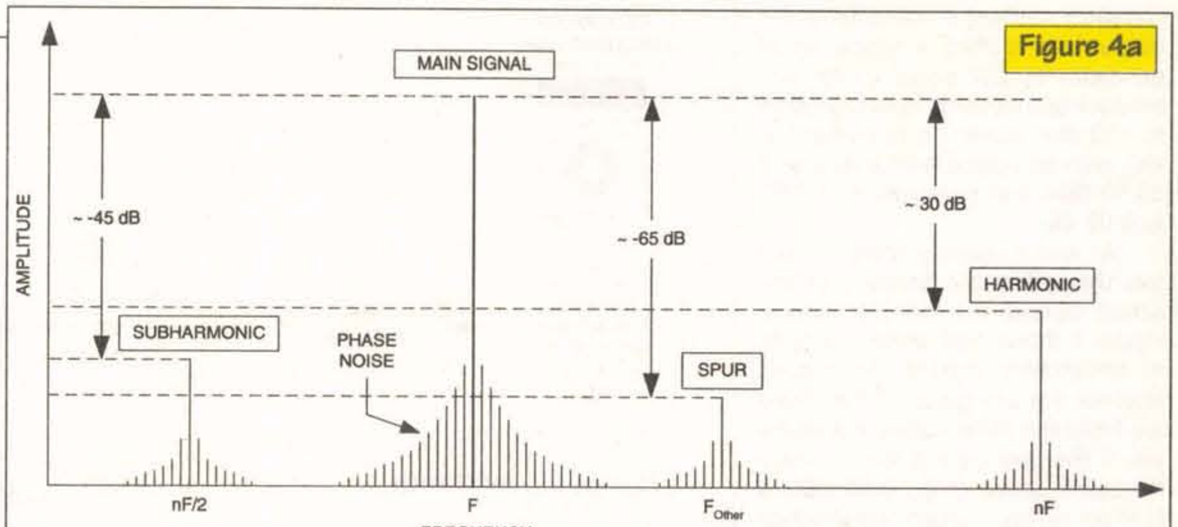


Figure 4a

To find the level in watts divide Equation (3) by 1000.

Output Signal Quality

It would be nice if all signal sources and signal generators were ideal, i.e., the output frequency and output level are noiseless and perfectly calibrated. That never occurs, although the differences in these specifications is a principal difference between high and low quality instruments.

Frequency

The important considerations regarding frequency are the range, resolution, accuracy, and (in automatic test equipment applications) the switching speed.

Range. The frequency range is a specification that tells the specific frequencies that are covered. In some cases, there will be only one frequency, or some small number of discrete frequencies. In other cases, one or more bands of frequencies are provided.

Resolution. The resolution is the statement of the smallest increment of frequency that can be set. On analog instruments that do not have a counter, the resolution is poor. The resolution may (but not certainly) be improved by adding a digital frequency counter to measure the output frequency. On modern synthesizers, it is possible to set frequency with extremely good resolution.

Accuracy. This specification refers to how nearly the actual output frequency matches the set frequency. The accuracy is a function of the set frequency (and how closely it can be set), F_{Set}, long-term aging (τ_{aging}) and the time since last calibration (τ_{cal}). Mathematically:

$$\text{Accuracy} = \pm F_{Set} \times \tau_{Aging} \times \tau_{Cal}$$

Example

A signal generator is set to 480 MHz, and has an aging rate of 0.155 ppm/year. It has been six months (0.5 year) since the last calibration.

$$\text{Accuracy} = \pm F_{Set} \times \tau_{Aging} \times \tau_{Cal}$$

$$\text{Accuracy} = \pm (480 \text{ MHz}) \times (0.155 \text{ ppm/year}) \times (0.5 \text{ year})$$

$$\text{Accuracy} = \pm 37.2 \text{ Hz}$$

There may also be some random variation in the output frequency. Figure 2 shows the uncertainty band around the set frequency. The actual output frequency, Fo, will be FSet ± Accuracy. It is the general practice to calibrate a signal generator on six-month or annual schedules, depending on the use.

Switching Speed (Settling Time). This is the length of time, usually in milliseconds or microseconds, that is required for a synthesized signal source or generator to move to a new frequency when digitally commanded to change. It is calculated as the length of time for the error of the frequency and/or output level commanded by the change to come into specification range.

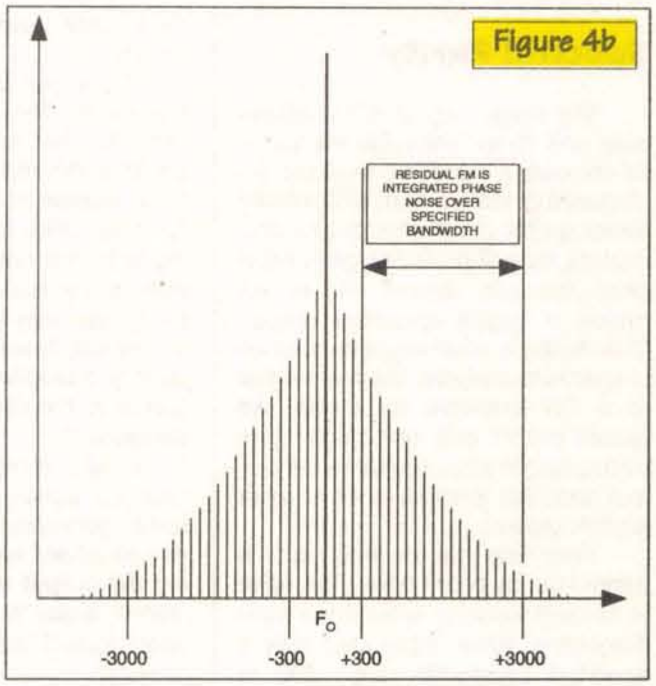
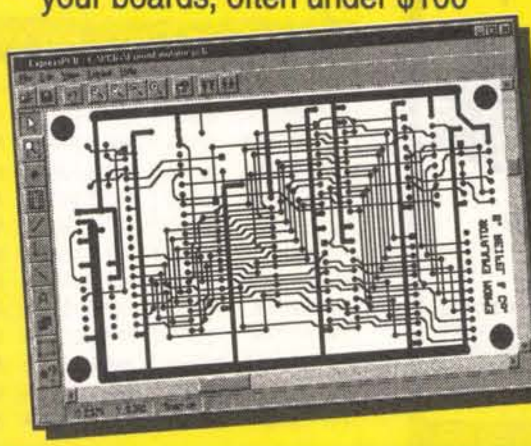


Figure 4b

Output Level

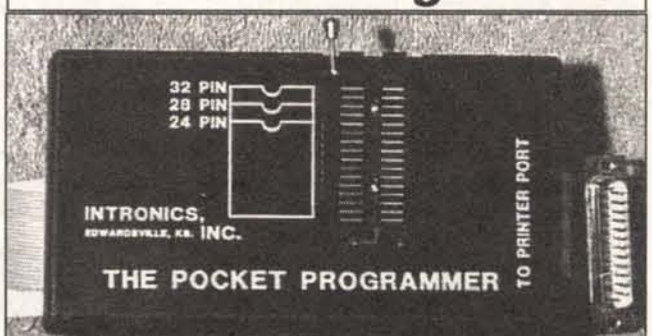
The output level can be expressed in either voltage, power, or dBm notations. All are equivalent, although one or the other will be preferred in most cases. The most

PCB LAYOUT
Software For Windows - FREE
❶ Download our board layout software
❷ Design your 2 sided plated-through PCB
❸ Send us your layout over the Internet
❹ In 2-3 business days, UPS delivers your boards, often under $100



www.expresspcb.com

The Pocket Programmer



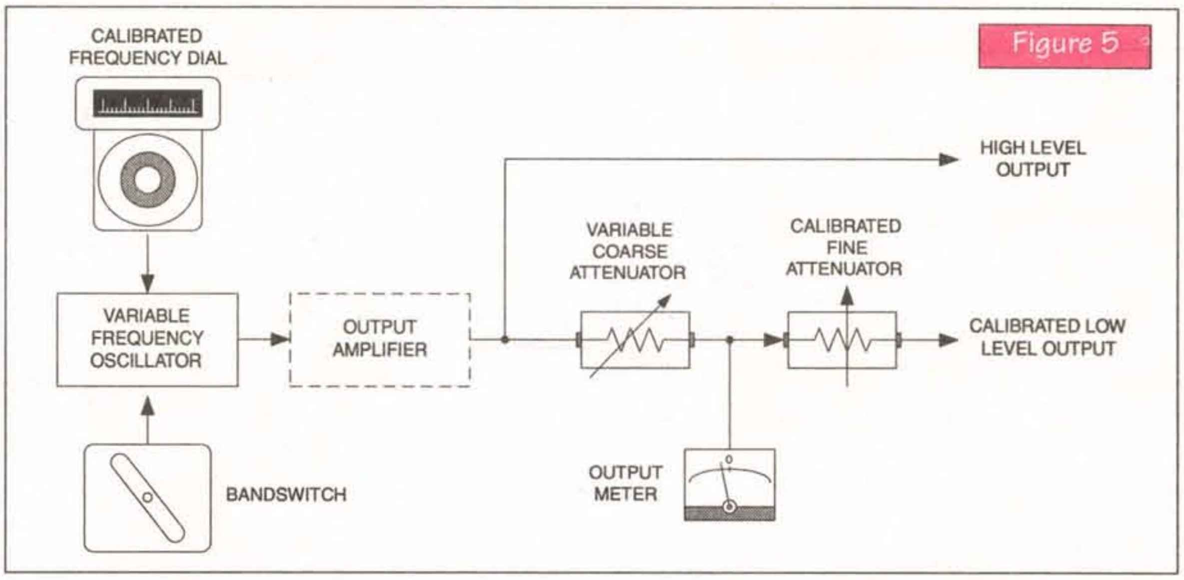
The portable programmer that uses the printer port of your PC instead of a internal card. Easy to use software that programs E(E)prom, Flash & Dallas Ram. 27(C)/28(C)/28F/ 29F/29CXXXX & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, MCU's 874X, 875X, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang, 82/74 Prom's and Eprom Emulator to 32K X 8.
Only $129.95

Same Name, Address & Phone Number for 16 Years.... Now isn't that Amazing ?

Intronics, Inc.
Box 13723 / 612 Newton St.
Edwardsville, KS 66113 Add $5.00 COD
Tel. (913) 422-2094 Add $4.00 Shipping
Fax (913) 441-1623 Visa / Master Charge / Amex

common method of describing the output level is dBm. A typical signal generator or CW signal source will produce output levels from -136 dBm to +10 dbm (some go to higher levels), with an output level accuracy of ±0.50 dBm and a resolution of 0.01 to 0.02 dB.

As with frequency, there are factors that affect the accuracy of the actual output vs. the set output. Figure 3 shows that there is a zone of uncertainty around the output level set. For any given setting, there are Pmin and PMax values. For example, if the only error is the accuracy discussed above (e.g., 0.50 dB), a level set of, say, -10 dBm will produce an actual output power level of -9.5 to -10.5 dBm.



Spectral Purity

The output signal is not always nice and clean. Although the purity of the output signal is one of the distinguishing factors that differentiate lower quality and higher quality generators, they all produce signals other than the one desired. Figure 4A shows a typical spectrum output. This display is what might be seen on a spectrum analyzer. The main signal is a CW sinewave so, ideally, we would expect only one single spike with a height proportional to the output level. But there are a lot of other signals present.

First, note that the main signal is spread out by phase noise. This noise is random variation around the main frequency. When integrated over a specified bandwidth, e.g., 300 to 3,000 Hz, the phase noise is called residual FM (Figure 4B).

Second, there are harmonics present in Figure 4A. If the main signal has a frequency of F, the harmonics have frequencies of nF, where n is an integer. For example, the second harmonic is 2F, and the third harmonic is 3F. In many cases, the 3F harmonic is stronger than the 2F harmonic, although, in general, the higher harmonics are weaker than lower harmonics.

There are also sometimes sub-harmonics. These are integer quotients of the main signal. Again, if the F is the main signal frequency, nF/2 represents the sub-harmonics. Typically, unless something is interfering with the output signal, sub-harmonics are not as prominent. One thing that does make sub-harmonics prominent, however, is the use of frequency multiplier or divider stages (which is the case in many modern generators).

Finally, there are miscellaneous spurious signals ("spurs") found on some generators. These might be due to power supply ripple modulating the output signal, parasitic oscillations, digital noise from counter or phase locked loop circuits, and other sources.

Harmonics and spurs are usually measured in terms of decibels below the carrier (dBc), where the carrier is the amplitude of the main output signal. In general, the lower the unwanted components are, the better the signal source.

Phase noise warrants some special consideration. It is usually measured in terms of dBc/Hz, i.e., decibels below the carrier per Hertz of bandwidth. This noise is concentrated around the main signal frequency, and is normally graphed on a log-log scale to permit both close-in and further-out noise components to be compressed on one graph.

Architectures

Although there are many different configurations, with different "block diagram" representations, there are only a few different architectures used in designing signal generators. Figure 5 shows a simple analog architecture that was once common on even high-grade instruments, and is still common on service grade instruments.

The signal is generated in an L-C controlled variable frequency oscillator (VFO). The VFO typically has a bandswitch for selecting different frequency ranges. A calibrated tuning dial gives the user an approximate idea of the output frequency. However, because of drift and the mechanical aspects of calibrating the dial, these dials are not terribly accurate.

Some instruments have an output amplifier although, for many decades, even quality signal generators lacked power amplifiers. The output of the VFO was fed directly to the output level control.

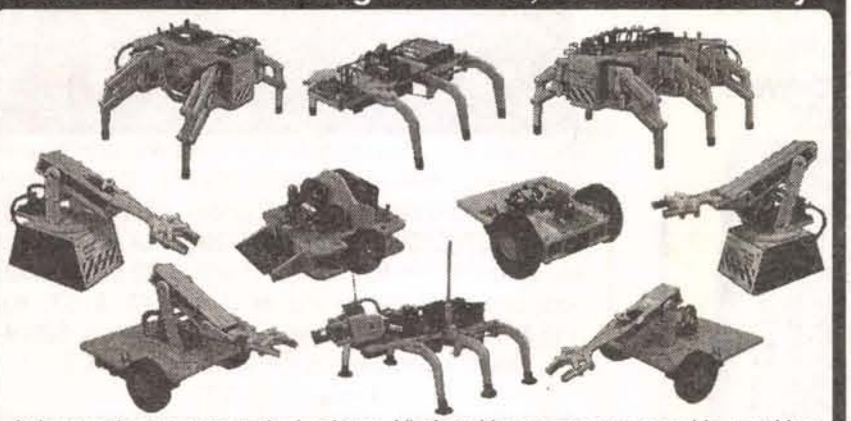
Service grade generators of this architecture usually have a crude form of output level control. Higher quality instruments, on the other hand, will have some variant of the output circuit shown in Figure 5. A high level output is sometimes provided to permit the user to route the signal to a frequency counter so that an accurate determination of frequency can be achieved.

There are two attenuators in the output level setting circuit. A coarse attenuator is used to set a relative output meter to some calibrated point. In most cases, the meter would be calibrated with a zero in the center of the analog scale. The coarse attenuator is adjusted to center the meter pointer over the zero point in the center of the meter. When this is done, the settings of the fine output attenuator are valid.

Other Types of Signal Generator

In the main, this article is about RF signal generators. But there are two other types of signal generator that have to be accounted for. First, there is the straight audio signal generator. Second, there is the function generator. The audio signal generator will produce a high quality sinewave output, and possibly also a squarewave output. It will possibly offer a precision output control, either by metering or by dial. These

Build Your Own Intelligent Robot, We Make It Easy!



At Lynxmotion we cater to the beginner. All of our kits are easy to assemble, requiring only common hand tools in the construction process. The detailed assembly manuals include 2D and 3D exploded view diagrams. The kits can be controlled or programmed in an easy to follow BASIC programming language. The technology is here, the costs are affordable, the support is available, join in and become a robot builder!

Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403
www.lynxmotion.com

Lynxmotion

Visit our website or ask for our free catalog!

Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

Equipment Management Technology

Moving Sale

Tel 650-631-1700 Fax 650-631-1200 Email sales@emt1.com

SELECTED SPECIALS!

HP 16505A	$250	HP E1345A	Make Offer!
HP 16510A	$100	HP E1347A	Make Offer!
HP 16515A	$100	HP E1364A	Make Offer!
HP 16516A	$400	HP E1400B	Make Offer!
HP 3314A	$1400	HP E1401A	Make Offer!
HP 5335A	$500	HP E1662A	Make Offer!
HP 59501B	$250	HP E1671A	Make Offer!
HP 6266A	$250	HP E1672A	Make Offer!
HP 8016A	$500	HP E1681A	Make Offer!
HP 83545A	$3850	HP E1682A	Make Offer!
HP 8493B	$100	HP E1693A	Make Offer!
HP 8958A	$5000	HP E1725A	Make Offer!

We buy, rent, and sell high quality test and measurement products. We occasionaly offer great deals on computers as well.

HP OmniBook 600C color subnotebook weighs a mere 3.7lbs for ultimate portability. Special Nuts & Volts price is only **$250!**

956 Bransten Road
San Carlos, CA 94070

NEW ADDRESS

Dave is test equipment!
Bigdave@emt1.com
Kerry is computers!
kwhite@emt1.com

Write in 31 on Reader Service Card.

Write in 32 on Reader Service Card.

signal generators universally have a 600-ohm output. What is also true is that they rarely cover more than the audio frequencies (20 Hz to 20 KHz), although a few go to 100 KHz. Function generators, on the other hand, may go to 1 MHz or 2 MHz for common grades, to over 20 MHz in some grades.

Function generators differ from straight audio generators in that they have three or more functions: sine-, square-, and trianglewaves. They usually have multiple outputs, or are switch-selectable between 50 ohms, 600 ohms, and TTL output. The typical function generator also differs from the audio generator in that the output control is rather crude being a single knob control.

Communications

I am behind in answering my mail. Since returning from Ireland and Scotland, I haven't been as diligent about the mail as before, so if you've written to me in the last six months, please be patient as I am getting around to the bottom of the pile in due course. My "day job" (the one I do when I am not writing) has gotten very busy recently, and that adds to the problem. It is usually better to communicate with me via E-Mail if you want to be answered quickly as I usually answer those in a day or two (see Connections ... below). I will get caught up soon, so be patient ... please.

British Boatanchors

A "boatanchor" is a radio that glows in the dark, i.e., a vacuum tube radio. In the United States today there are a number of boatanchor collectors (and, in fact, we have a list server on the Internet: boatanchors@theporch.com). While in the United Kingdom, I had the opportunity to visit a London-area based boatanchor museum during a boatanchor event.

It was interesting to see the differences in design philosophy between American and UK based designers. Most of the radios were of the superheterodyne design, but that is where the similarity ends. The cabinetry of the UK designs look different from American cabinetry (including a few "round" radios!). Other than that, the shape factors of the radios were different from typical American designs.

Speaking of boatanchors, I am a fan of the Hallicrafters SX-28A "Super Skyride" model. There is a web site devoted to the SX-28: http://www.exit109.com/~jimh/hallicrafters.shtml. Go take a look at it if you are so inclined.

New Book

I have a new book out. It is *Joe Carr's Loop Antenna Handbook*, and it is published by Universal Radio [6830 Americana Parkway, Reynoldsburg, OH 43068; phones **1-800-431-3939**; info **614-866-4267**; FAX **614-866-2339**]. It is priced at $19.95.

The chapters include: Radio Signals and Reception, Special Loops for Shortwave, Large Loop Theory, Large Loop Construction, Loop Sticks, Radio Direction Finding, Large Loop Antenna Projects, Quad Loop Beam Antennas, Small Loop Theory, Small Loop Deployment, Small Loop Preamplifiers, Additional Small Loop Topics, Small Loop Antenna Projects, Other Matters of Interest, and Some Commercial Products.

Next month ...

Next month, we will talk about frequency synthesizers — the king of signal generators — as well as several other topics applicable to all high quality signal generators. **NV**

Connections ...

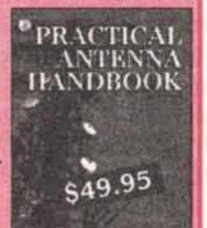
I can be reached by snail mail at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at CARRJJ@AOL.COM.

2 Great Books by Joseph Carr

SECRETS OF RF CIRCUIT DESIGN

From one of today's most respected electronics authors comes this pragmatic, intermediate-level guide to designing, building, and testing all types of radio frequency circuits. Filled with functional projects that demonstrate the principles of RF circuits, this revision of a bestseller also provides a handy parts list and sources of components.

PRACTICAL ANTENNA HANDBOOK



The most popular book on antennas ever written, widely known as "the antenna builder's bible."

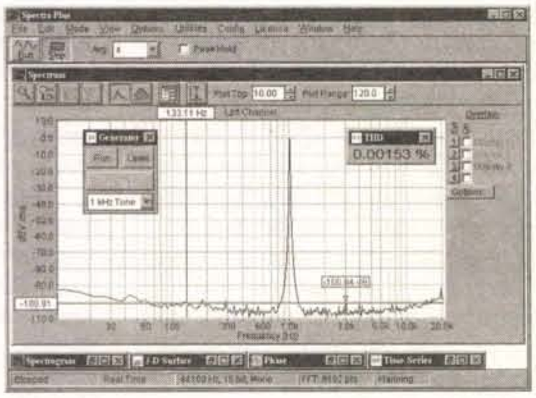
This *Third Edition* is a work for anyone with an interest in antennas, from the newest of novices to the most experienced engineer. This empowering book gives you all kinds of projects and material that explains why what you did works.

As a paid subscriber to *Nuts & Volts*, you'll receive **10%** off the list price!!

(See ad on page 50 for ordering details and other titles currently available.)

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features
- 20 kHz real-time bandwith
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes



Applications
- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

Priced from $299

(U.S. sales only – not for export/resale)

System Requirements
- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

DOWNLOAD FREE 30 DAY TRIAL!

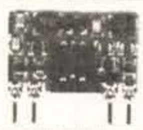
www.spectraplus.com

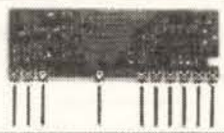
PHS Pioneer Hill Software 24460 Mason Rd. Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.

Spectra Plus *FFT Spectral Analysis System*

Sales: (360) 697-3472 Fax: (360) 697-7717 e-mail: pioneer@telebyte.com

RF Data Modules





AM TRANSMITTER
- Small size: 17.78 x 11.43mm
- CMOS/TTL input
- No adjustable components
- Low Current. 4mA typical.
- 418MHz or 433.92MHz OOK
- Simple to integrate -simply add antenna, data and power
- Range up to 250ft.
- Wide supply range, 2-14Vdc
- SAW controlled - stability
- Also available in DIL package

AM-RT5 .... $12.10

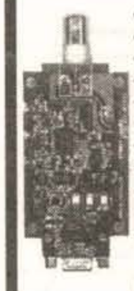
AM RECEIVER
- Compact size: 38.1 x 13.7mm
- On-board data recovery. CMOS
- Low current. 2.4mA typical
- 2kHz data rate. CMOS/TTL output
- 5Vdc operation
- On 418MHz or 433.92MHz (4xx)
- No adjustable components
- Patented Laser Trimmed component
- High stability
- Sensitivity: -105dBm
- Available also in 0.8mA version

AM-HRR3-4xx $10.95

FM TRANSCEIVER
- Only 23 x 33 x 11mm
- Up to 40k bps data rate
- 19200 baud with ASCII
- Up to 500ft. range
- 5v operation
- 0.25mW into 50
- 418 or 433MHz FM
- Fast 1ms enable
- Direct interface to 5V CMOS
- Auto TX/RX changeover

BIM-4xx-F $87.36

RS232 TRANSCEIVER MODULES



- 4,800 to 38,400 bps half duplex
- 3-wire RS232 interface
- μController with user EEPROM
- RS232 interface protected to ±15kV
- Data packetizing performed by user
- Auto TX/RX changeover
- 418 MHz and 433MHz versions
- Range up to 500ft. (0.25mW ver.)
- 0.25mW & 10mW versions
- Reset switch and status LED's
- 7.5-15V dc via DB9 connector, 20mA

BIM-4xx-RS232 .... $139.30

70 x 65 x 15mm

- Up to 19,200 bps half duplex
- 3 wire RS232 interface
- Range up to 500ft
- Transparent data packetizing
- Supports 8 or 9 bit protocols
- Self test function
- Reset Switch & Staus LED's
- 1/4 wave wire antenna on board
- Available in a Simplex Tx/Rx pair.(RTcomTX & RTcomRx)
- 7.5V-15Vdc operation

Transceiver.......... RTcom-4xx............... $247.90
Transmitter.......... RTcomTx-4xx........... $ 87.15
Receiver.............. RTcomRx-4xx........... $105.52

ABACOM TECHNOLOGIES

Free Catalog

Tel: (416)236-3858
Fax: (416)236-8866
www.abacom-tech.com
abacomtech@compuserve.com

Write in 33 on Reader Service Card.

AMATEUR ROBOTICS NOTEBOOK

by Robert Nansel

As I had hoped, I had a big response to my November call for people looking for robotics clubs and those who already belong to clubs. Because there were so many responses, though, I don't have room this month to include the high-level I2C routines I promised, so that will have to wait for next month. Check out the sidebars for people in search of clubs and clubs in search of people; I've checked what information I could, but no guarantees. If anyone spots errors in the club listings, in particular, I'd appreciate hearing about it.

Also, in the spirit of helping beginners get going in robotics, I'm starting a multi-part tutorial on the heart of robotics: motor control. I'm planning some bigger robot projects this year, which will require more oomph than hobby servos can economically provide.

Although the series is primarily for beginners, I've found that even seasoned gearheads don't always understand what's going on in their motor drive circuitry. My goal in this series is to help y'all — rank newbies and grizzled veterans alike — develop a gut-level feel for what it takes to make a motor perform the way you want it to (as well as lots of tried-and-true circuits).

I also seem to recall saying something in November about a prize for entering the Lonely Gearhead contest. Yes, it's all coming back to me ... some lucky robot nut out there is supposed to get a free GrowBot kit (to find out who, you'll just have to read the rest of the article).

First up, though, is a correction to last month's column. Somehow the first couple paragraphs got clobbered in transmission of the section on the improved I2C master. This is how it should have read:

Figure 1: Unidirectional Motor Drives

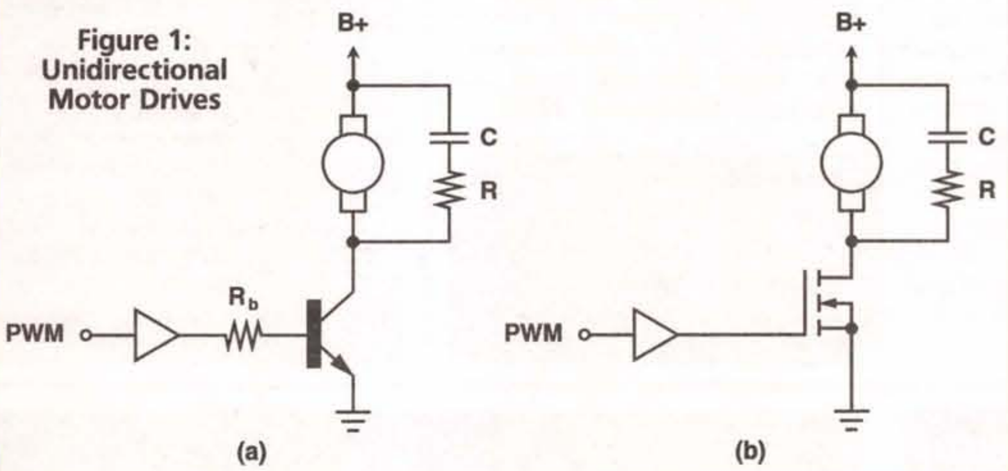
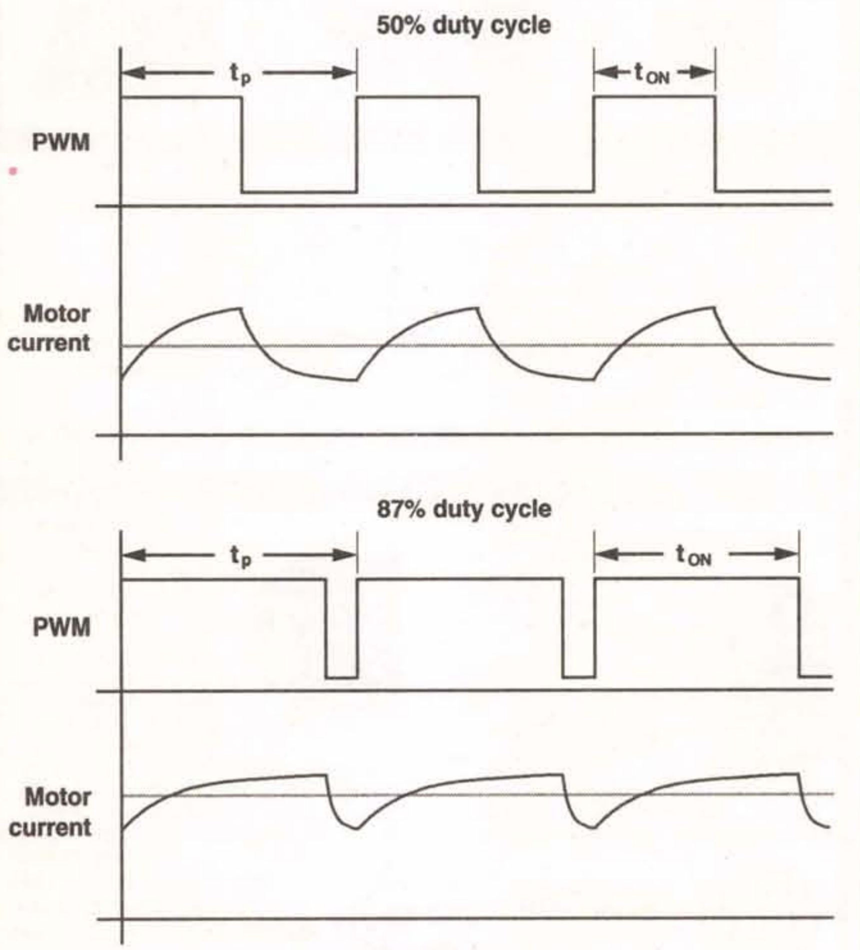


Figure 2: PWM & Motor Current



duty cyle = $(t_{ON} / t_p) \times 100\%$

The last two columns I've been using essentially the same version of code for the I2C master. That version was feeble, barely smart enough to generate I2C waveforms so I could bootstrap my I2C slave code. Except for checking for the Bus Free condition, it blissfully ignored the outside world as seen through the SDA and SCL lines. The master pulled off this trick by sending all ones for the second byte of the datagram, thus enabling a slave to jump in and put data on SDA without contention. This month, it's time to make the master pay attention to what the slave has to say, and that means that the master's get_byte routine must be tested.

The resulting code is shown in Listing 1 [see Dec. '99]. In keeping with the iterative design method, this master works fine with last month's slave.

What's All the Jitter?

The 'scope shot shows the datagram as it appears on SDA (the top trace) and SCL (the bottom trace). Notice that the second half of both traces show a fair amount of jitter. This is not caused by the slave clock-stretching; last month's [Nov. '99] slave is fast enough that it releases SCL before the master is done with Tlow. Rather, it's caused by the slave's inability to synchronize any closer to the master's SCL transition than 0 to 4 instruction cycles. This is still well within the timing constraint of 12 cycles for Tlow, so everything works fine.

Motoring Along

Driving permanent magnet DC motors can seem mysterious and complex at first. It's easy to get overwhelmed with terms like Pulse Width Modulation, Locked Antiphase, H-bridges, Circulating Current, Snubber Networks, and Duty Cycle. Driving PM DC motors isn't hard, though, if you remember some basics.

First, realize that PM DC motors respond to both voltage and current. The steady-state voltage across a motor determines the motor's running speed, but the current through its armature windings determines the torque. Apply a voltage and the motor runs (say) clockwise; reverse the polarity and it runs counterclockwise.

If you apply a load to the motor shaft, it will draw more current. If the power supply isn't "stiff" enough, the voltage will drop and the speed of the motor will drop. But if the power supply can maintain voltage while supplying the current, the motor will maintain its speed. Voltage controls speed, current controls torque.

To a first approximation, PM DC motors respond linearly to voltage and current, which makes them much easier to control than wound-field motors, particularly series DC motors.

Unidirectional Motor Drives

The simplest motor drive circuit is a single direction drive. Figure 1 shows two common circuits. The buffers on the left represent logic level outputs (perhaps from a microcontroller). Figure 1a shows an NPN transistor used as a simple switch where the motor minus lead is pulled to ground whenever a logic "high" biases the NPN transistor ON. Rb must be chosen so the current into the base is sufficient to fully saturate the transistor.

Figure 1b shows a MOSFET equivalent circuit. The NPN and MOSFET transistors act as switches, and they could even be replaced by

switches or relays if all you cared about was turning the motor full ON or OFF. As we shall see later, using transistors instead of relays is advantageous because transistors can be switched ON and OFF much more quickly than relays, and this allows the speed of the motor to be controlled.

In both circuits, the RC network across the motor is an example of a snubber network. Some snubbers use diodes to shunt current to ground or B+ (this is the function of the diodes across the relay coils in Figures 4 and 5). Others use resistors and capacitors.

In both cases, a snubber's purpose is to limit the voltage spikes produced by the motor and to provide a current path for motor current to flow temporarily when the transistor is turned off. This current flow is known as circulating current; it is important to provide a place for this current to go when the transistor shuts off.

Immediately after the transistor turns off, the motor will still be turning. If the current has nowhere to go the motor's inertia and inductance attempt to keep current flowing in the same direction. This causes the voltage across the motor to change polarity, possibly destroying the transistor in the process.

However, with the capacitor C across the motor, the current has a low impedance path to follow so no destructive negative spike is formed. While the transistor is ON, C charges to the voltage across the motor.

When the transistor turns off, C then gives up its charge, acting as a local reservoir of energy to keep the motor turning for a short time. Resistor R burns off this current and forces it to decay rapidly with no electrical ringing. The net effect is that your transistors won't blow up and relay contacts won't arc.

Speed Control

Now consider what happens when the transistor is rapidly turned ON and OFF in such a way that the frequency of the pulses produced remains constant, but the width of the ON pulse is varied, as in Figure 2. This is known as Pulse Width Modulation (PWM). Current only flows through the transistor during the ON portion of the PWM waveform. Initially, with the motor at rest and C discharged, no current would flow in the motor's windings; current through the motor ramps up, and C charges.

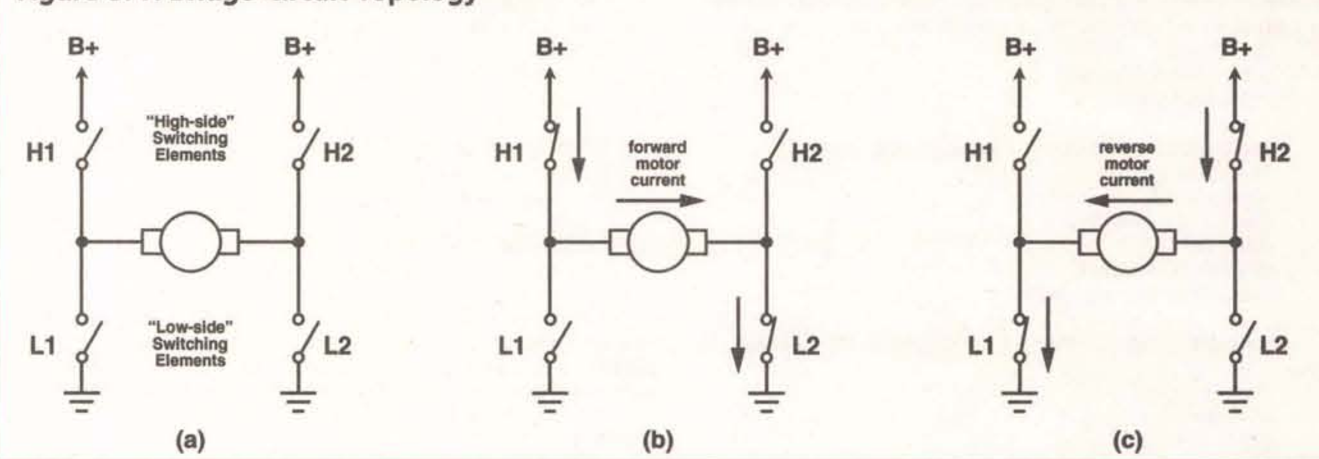
Before the motor reaches full speed, however, suppose the transistor turns OFF; this forces the motor to circulate current through R and C. Current decays until the transistor turns on again, then the whole cycle repeats. The motor "sees" a roughly trianglewave current. If the frequency of the PWM input is high enough, the mechanical inertia of the motor cannot react to the ripple in the trianglewave; instead, the motor behaves as if the current were the DC average of the trianglewave.

With a PWM duty cycle of 25%, the motor would "see" about a third the current that would flow with a PWM duty cycle of 75%, and would turn at roughly a third the speed, depending on the mechanical load. For a constant load, the motor speed will be proportional to the duty cycle of the PWM input.

Direction Control

You could build a robot using only unidirectional motors. In practice, this would severely limit the robot's mobility. It would be unable

Figure 3: H-Bridge Circuit Topology



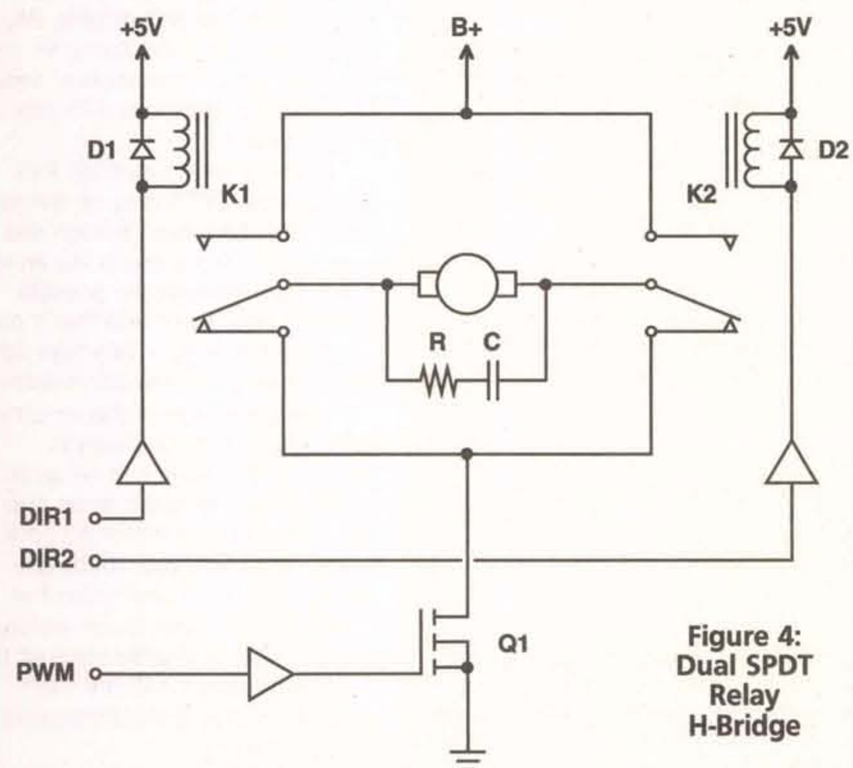
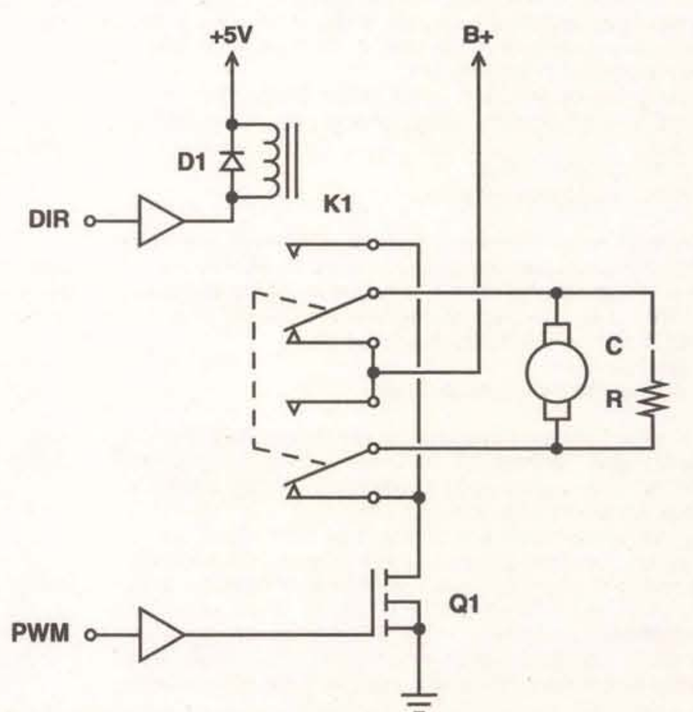


Figure 4: Dual SPDT Relay H-Bridge

Figure 5: DPDT Relay H-Bridge



THERE IS A FREE LUNCH AFTER All – 500 resistors sent absolutely free with order of $10.00 or more. Sell them to your friends for 1¢ or 2¢ and treat yourself to a $5.00 or $10.00 lunch! Spend $25.00 and we'll send 1,500 (Lunch for 2).

ER Digital Multimeter	$17.95	1N4005 (600V-1A) (100)	$4.95
ER Analog Multimeter	6.95	1N914 (75V-10mA) (100)	2.95
SO-239 Connector	.95	1N4148 (75V-10mA) (100)	2.95
PL-259 Connector	.95	2N3904 (NPN) (100)	8.00
6-pc Precision Screwdriver Set	1.50	2N3906 (PNP) (100)	8.00
10 Pair Alligator Clip Leads	2.95	2N3055 (NPN) GP	.65
10 T 1 3/4 LEDs (green, red, yellow)	1.25	2N5239 (NPN) HV GP Amp	1.50
12V - 60Amp Starter Switch	9.50	2N5684 (PNP) 50A-300W Hi-Pwr Amp	3.00
Pocket Telescoping Magnet	2.95	2N5686 (NPN) 50A-300W Hi-Pwr Amp	3.00
40-pc Carbon Steel Tap & Die Set	19.95	Set of 4 Wax Carvers/Picks	3.95
AA Ni-Cad Battery	.95	6" Plastic Vernier Caliper	1.50
1# 60/40 Solder	7.95	Pad of 56 Stick-on Feet	2.50
30W Solder Iron	2.95	4" Black Tie Wraps (100)	2.50
XLR-3 Pin Male Connector	2.00	12-1/2W - 1.5K Rheostat	4.75
XLR-3 Pin Female Connector	2.25	50V-2A Bridge Rectifier	.75
Mini Toggle Switch SPDT On-Off-On	.50	2-Way Splitter (5-900 MHz)	.95
Mini Toggle Switch DPDT On-Off-On	.60	RJ45 Connector	.25
Full Size Toggle DPDT 15A-3/4 HP	2.00	Banana Plugs (Red or Black)	.30
3-Wire Trailer Connector (M&F)	3.25	Universal 1 Amp AC/DC Adapter with 7 Different Voltages	4.95
4-Wire Trailer Connector (M&F)	3.95		
Mini Snap-in Rocker Switch 6A	.45		
1N4001 (50V-1A) (100)	4.95		

Add $3.50 for shipping and handling. CA Buyers add 7.75% Sales Tax.

HYATT ELECTRONICS, 371 N. Johnson Ave., El Cajon, CA 92020
Tel. **(619) 444-2434** • Fax **(619) 444-1987**

My name is Jim Hepting and I am interested in a club. However, I live in Kitimat, British Columbia located in the center of the province on the coast (about 400-500 miles north of Seattle).

Jim Hepting
jhepting@methanex.com

I'm wondering if there is anyone working on robots in the Gold Country area of California within an hour of Grass Valley. I'm interested in finding others so we can exchange ideas, parts, etc., or just generally twiddle around with robots. Thanks.

Matthew Woolsey
mwoolsey@psn.net
mattwoolsey@mad.scientist.com

Hopefully others in the Sierra foothills will respond ... maybe get a Gold Country robotics club going.

Nick Taylor
ntaylor@iname.com

I'm in Berkeley, CA.

Tobin Fricke
tobin@sji.org

I regularly enjoy the column in *Nuts & Volts.* Saw your "gearhead" challenge in the Nov. issue. I'm presently clawing my way up the steep edge of the learning curve of robotics, mostly through reading everything I can get my hands on and trying to learn enough code to perform wonders with the two BASIC Stamp II chips that I have. Please include me in your list of contacts.

Mike Barry
3101 Vallejo St.
Riverside, CA 92503
myklb@aol.com

I'm Dan, and live in east central Florida, about halfway between Orlando and Daytona Beach. Sure would like to hook up with anyone interested in robotics in this area.

Dan Chiodo
dchiodo@mpinet.net
(407) 668-5040

I am interested in locating a robotics club locally.

Eben Whitcomb
39 Waterside Ln.
Clinton, CT 06413
(860) 669-7068
dirigo@uconect.net
www.uconect.net/~dirigo

Looking for club or other robot builders in the Orlando, FL area.

Doug Leppard
DLeppard@ccci.org
(407) 384-6545

I am a regular reader of your "Amateur Robotics" column in *Nuts & Volts*, and I saw your offer to assemble a list of "orphan roboticists." I think it is a great idea. I know that many people in the Boston area work on mobile robots, folks from the AI Lab at MIT, IS Robotics, Draper Labs, etc. – but I have yet to meet any individual hobbyists. It would be great to find out about any clubs here in the area, or perhaps other folks who are interested in starting one!

I live in Natick, MA, and I work in Cambridge, but I am interested in anything in the Boston metro area, if it makes a difference.

R. Mark Adams, Ph.D.
rmadams@epotential.com.

Anybody know of a club in Nebraska? Anybody even from Nebraska? (Besides me.) Anybody know where Nebraska is? If you are ... from Omaha/Lincoln, send me an E-Mail and even if there isn't a club, we could get together and discuss 'bots. Helps to have someone to bounce ideas off.

Dan Creagan
dcreagan@scholars.bellevue.edu

I am the Secretary/Treasurer for the Connecticut Robotics Society based in Hartford, CT. Now that is great in and of itself. We usually draw around 20-25 people each month, and the meetings are pretty lively. My problem is that I live in the Albany, NY area which is not all that close to Hartford. So, each month, for about the past couple of years, I've been driving a total of 5 hours (2.5 hours each way) from home to the meeting and back. The rest of the time I communicate with my fellow members via E-Mail.

It would be great to start a club here in the upstate New York area where I live, and find a few folks who would like to build robots with me. So, if you run across anyone who lives near me in the Albany, NY area ...

Jim Salvino
73 Spring Rd.
Scotia, NY 12302
(518) 374-1394
jims@capital.net

I read your article in the 11/99 *Nuts & Volts*, and I would be interested in finding out about clubs in my area. Over a year ago, I subscribed to *Nuts & Volts* specifically to learn more about robotics and to get more involved. I have half-heartedly been searching for a club in my area, but have not been successful, and would appreciate any help you could lend ... I am located in Queens, NY, about 25 minutes from Manhattan, 10 minutes from Nassau County, and one hour from Suffolk County. I would like to hear about any clubs that you may know of in my area.

Michael Cassidy
pmcassidy@mindspring.com

I am interested in finding others from my area of the map who are interested in robotics. I don't know how far north your list of clubs spans; I'm up here in Canada, attending my second year at Royal Military College, Kingston, Ontario. My address is:

II North
1 Sqn
RMC
Box 17000, Stn. Forces, CFB Kingston
Kingston ON
Canada
K7K 7B4

So far, I've hooked up with the robotics lab here at the College, but I was wondering if there were any clubs in the Kingston area. Thanks.

Eric North
s22274@rmc.ca

I am looking for a club in the Sault Ste. Marie, Ontario (Canada) or Northern Michigan area.

Pat Caron
kacpac@sympatico.ca
(705) 759-4602

Count me in on the club listing. Looking for a club in the Ottawa/Hull, Ontario (Canada) area.

Stephen Winsor
(819) 459-1506 (B)
(819) 459-2069 (fax)
Winsor_Consulting@ottawa.com

Your column in *Nuts & Volts* is correct; I do think I'm the only one who wants to build hobby robots. I've mentioned starting a club to people from time to time, with no interest. Although I don't have enough time right now to organize a club, I'd love to join one in my area: Philadelphia, PA or Wilmington, DE.

Kathy Garges
(610) 459-1897
gargesks@pond.com

I enjoy the interesting articles you have written. If you find out that there is a robot club in the northern Utah area, would you please publish that info? Thanks.

Gary Harston
zaphod@uswest.net

I'm interested in being a member of a robot club in Spokane, WA. Your efforts are appreciated.

Terrel Nichols
tnichols@tei.com

I am interested in robotics clubs in the Milwaukee, WI area. I hear that there might be one at UW Parkside, but have not found any info. Thanks for playing matchmaker to robotics enthusiasts.

Tom Gralewicz
mot@ieee.org

I read your article (Amateur Robotics Notebook) in *Nuts & Volts* magazine, and am interested in finding a robot builders club in Milwaukee, WI. Thank You.

Linda Szeremet
szeremet@worldnet.att.net

I am a roboticist in England (for all of you who think stereotypical England is cold and wet, it's not – most of the time!). Anyway, I'd be glad if anyone could get back to me – I live on the south coast and would be willing to start up a club.

Angus Thomson
angus@ukmax.com

to back up, for instance, nor would it be able to pivot in place. For worthwhile mobility, a robot must have full directional control over its drive motors. The way to accomplish this is through H-bridges.

H-bridges take their name from the shape of the circuit as conventionally drawn; it resembles a capital H with switching elements in both the high-side and low-side branches of the H (see Figure 3). With an H-Bridge, a motor can be made to run forward, reverse, or even brake to a halt.

The Classic H

Figure 4 shows such a circuit implemented with two SPDT relays and a MOSFET. With neither relay coil energized, or both coils energized, the pole contacts are shorted together. In both cases, nothing happens when the PWM signal turns the MOSFET ON because shorting the leads of the motor together tends to lock the rotor in place, a useful form of braking that comes for free with this circuit.

If one side or the other is energized alone, however, a current path is created when the MOSFET turns on. If DIR1 is high and DIR2 is low, relay 1 will pull its pole to the B+ contact and relay 2 will remain unenergized with its pole pulled to ground through the MOSFET. If DIR2 is high and DIR1 is low, current will flow in the opposite direction through the motor.

If you don't need speed control, the transistor in Figure 4 could be replaced by a direct connection to ground. The motor would then operate either full forward, full reverse, or locked rotor.

(As an aside, the winner of the contest is Kathy Garges gargesks@pond.com in the Philadelphia, PA, Wilmington, DE area. Kathy, let me offer you my congratulations; send your mailing address and I'll ship your GrowBot.)

Figure 5 shows a circuit that uses a single DPDT relay to reverse motor direction. Even though this circuit doesn't look much like an H, if you trace through the possible current paths, you'll find that it has the same topology – two high-side switches and two low-side switches.

The advantage of this circuit is its simplicity: only one relay is required. The motor can be wired so the relay only needs to be energized to make the motor go backwards. Assuming your robot will spend most of its time going forward, this can mean lower average battery drain. A disadvantage of the single relay circuit is that it can't short the motor terminals together to allow braking.

Also, if the transistor fails and

shorts to ground or, if the PWM input gets stuck high, the motor will run, regardless of the state of DIR. The two relay configuration isn't susceptible to this because the motor only runs when either of the relays – but not both – are energized.

And the Winner Is ...

Ha, fooled you. Go back and read the article; the winner is in the middle, somewhere inconspicuous.

And those of you shy people out there who haven't yet contacted me about your robotics club (or search for same), here's another chance: Send me your club listing and your name and contact info by March 1, 2000, and you'll be eligible for the next Lonely Gearhead drawing (I'll let you know what the prize is next month, as soon as I figure it out).

If you're convinced nobody but you builds robots in your part of the world, think again. We're everywhere.

Next time, I'll look at completely solid-state motor driver circuits, review books of interest to robot builders, and update the I2C project. **NV**

As always, if you have suggestions for improving Breadbot, if you've built a Breadbot, or if you have questions or comments about amateur robotics topics, you can reach me at:

Robert Nansel
69 S. Fremont Ave. #2
Pittsburgh, PA 15202
E-Mail:
bnansel@nauticom.net

City & State: **Russellville, AR**
Group Name: Arkansas Tech University IEEE student branch
Contact: Dr. Murray Clark
Email: murray.clark@mail.atu.edu
URL: engr.atu.edu/Projects/engr/EGR_HME.htm
Meetings:
Address: Murray Clark
ATU Engineering Dept.
Highway 7 North
Russellville, AR 72801
Telephone: (501) 964-0876

City & State: **Hartford, CT**
Group Name: Connecticut Robotics Society
Contact: Jacob Mendelssohn
Email: JMENDEL141@aol.com
URL: family.knick.net/salvinoj/crs/
Meetings:
Address:
Telephone:

City & State: **Anaheim, CA**
Group Name: Robotics Society of Southern CA
Contact: Art LeBouthillier
Email: apendragn@earthlink.net
URL: home.earthlink.net/~apendragn/rssc
Meetings: 2nd Saturday of month at Room EE321
California State University Fullerton
12:30-1:00 Business meeting
1:00-3:00 General meeting
Address: RSSC
P.O. Box 26044
Santa Ana, CA
92799-6044
Telephone:

City & State: **San Diego, CA**
Group Name: SDRS – San Diego Robotics Society
Contact: Peter Cresswell
Email: peter.cresswell@funtv.com
URL: www.eGroups.com/group/sdrs-list
Meetings: 1st Saturday at ITT Techical Institute, San Diego,
9AM - 12PM General meeting
Address:
Telephone:

City & State: **San Jose, CA**
Group Name: Palo Alto Homebrew Robotics Club
Contact: Bill Benson
Email: wbenson@ibm.net
URL: www.augiedoggie.com/HBRC/index.html
Meetings: Last Wednesday of each month (no meeting in Dec.)
Held at 7:30 PM, library of Castro Middle School
Address: Castro Middle Scool
4600 Student Ln.
San Jose, CA 85130
Telephone: (408) 874-3300

City & State: **San Francisco, CA**
Group Name: San Francisco Robotics Society of America
Contact: Roger Gilbertson
Email: SFRSA@mondo.com
URL: www.robots.org
Meetings: 1st Wednesday, 7:30 PM
at the San Francisco Exploratorium
Address: 3601 Lyon St.
San Francisco, CA 94123
Telephone: (415) EXP-LORE

City & State: **Aurora, CO**
Group Name: Rockies Robotics Group
Contact: Frank Arteseros
Email: kiko2@ix.netcom.com
URL: www.he.net/%7Eroundy/RRG.html
Meetings:
Address:
Telephone:

City & State: **Colorado Springs, CO**
Group Name: Pikes Peak Robotics Group
Contact: Jay Snively
Email: pprg@pcisys.net
URL: www.pcisys.net\~phantom\pprg.htm
Meetings:
Address:
Telephone:

City & State: **Atlanta, GA**
Group Name: Atlanta Hobby Robot Club
Contact: C. Barry Ward, president
Email: cbward@abraxis.com,robotclub@idea-vision.com
URL: www.botlanta.org
Meetings:
Address:
Telephone: (770) 663-3420

City & State: **Peoria, IL**
Group Name: Central Illinois Robotics Group
Contact: Jim Munro, Alan Kilian
Email: jimmn@xnet.com, kilian@pobox.com
URL: www.circ.mtco.com/
Meetings: 3rd Sunday (?), 1:00 p.m.
Address: Lakeview Museum of Arts & Sciences
1125 West Lake Ave.
Peoria, IL 61614-5985
Telephone: (309) 686-7000

City & State: **ISU, IA**
Group Name: Iowa State University Robotics Club (ISURC)
Contact:
Email:
URL: www.public.iastate.edu/%7Estu_org/ISURC/
Meetings:
Address:
Telephone:

City & State: **Wichita, KS**
Group Name: Wichita Robot Club
Contact: Laris Pickett, president (lpickett@ontargetusa.com)
Tom Light VP, (tlight@club-net.org)
Greg Carpenter (WfU@compuserve.com)
Email: help@robot-club.org
URL: kansas.robot-club.org/
ourworld.compuserve.com/homepages/wfu
Meetings:
Address: 1730 Charleston
Wichita, KS 67219-1609
Telephone: (316) 744-8600 (voice)
(316) 744-3030 (fax)

City & State: **Minneapolis, MN**
Group Name: Twin Cities Robotics Club
Contact: Rand Whillock (whillock@htc.honeywell.com)
Email: tcrobots-request@orbis.net
URL: www.tcrobots.org/
Meetings: 3rd Thursday of each month, 7 to 10 PM
Science Museum of Minnesota in St. Paul
Address:
Telephone: (612) 404-2009

City & State: **Nashua, NH**
Group Name: Nashua Robot Builders Club
Contact: Quentin Lewis
Email: bigqueue@tiac.net
URL: www.tiac.com/users/bigqueue/others/robot/homepage.htm
Meetings:
Address:
Telephone:

City & State: **Los Alamos, NM**
Group Name: Northern NM Robotics Group
Contact: Mark Dalton
Email: mwd@cray.com
URL:
Meetings:
Address:
Telephone:

City & State: **Raleigh, NC**
Group Name: Raleigh Triangle Amateur Robotics Group
Contact: Russell Lyday, president, Alan Porter webmaster
Email: r.lyday@worldnet.att.net, alan.porter@ericsson.com
URL: http://welcome.to/TAR
Meetings: 7:30pm on 1st Monday at Clark Labs
Room 110, North Carolina State University
Address: 10 Clark Labs
North Carolina State University
Raleigh, NC
Telephone:

City & State: **Cleveland, OH**
Group Name: Robo CWRU R&D Group
Contact: Joyce A Boone
Email: jab3@po.cwru.edu
URL:
Meetings:
Address:
Telephone:

City & State: **Troy, OH**
Group Name: The Miami Valley Robotics Club
Contact: Jon Magin (jmagin@allegro.net)
Email: robots@bright.net
URL:
Meetings:
Address:
Telephone:

City & State: **Waterloo, Ontario**
Group Name: Canada IEEE Student Branch
Contact: Ed Spike
Email: spike@eestaff.watstar.uwaterloo.ca
URL:
Meetings:
Address:
Telephone:

City & State: **Portland, OR**
Group Name: Portland Area Robotics Society
Contact: Marvin Green
Email: marvin@agora.rdrop.com
URL: www.rdrop.com/users/marvin/
Meetings: 1st Saturday of each month
at Mt. Hood Community College.
Room #1277 at 10:30 AM
Address:
Telephone: (503) 666-5907

City & State: **Pittsburgh, PA**
Group Name: CMU Robotics Club
Contact: Ryan Miller
Email: jmce@cs.cmu.edu
URL:
Meetings:
Address:
Telephone:

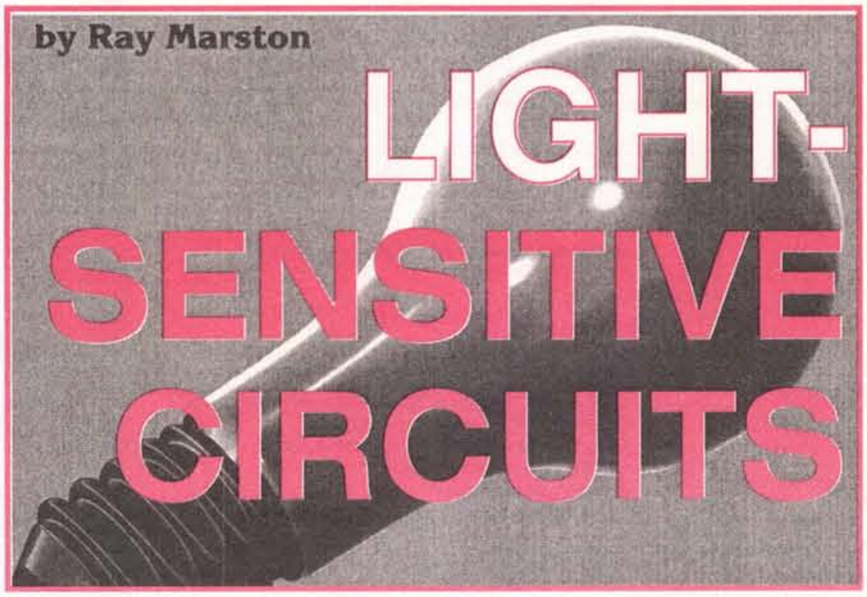
City & State: **Austin, TX**
Group Name: The Robot Group
Contact: Alex Iles, Don Colbath
Email: robo@robotgroup.org, dcolbath@austin.rr.com
URL: www.robotgroup.org/
Meetings:
Address:
Telephone:

City & State: **Dallas, TX**
Group Name: Dallas Personal Robotics Group
Contact: Clay Timmons, Kipton Moravec
Email: ctimmons@asic.sc.ti.com, kmoravec@airmail.net
URL: www.dprg.org/
Meetings:
Address:
Telephone:

City & State: **Seattle, WA**
Group Name: Seattle Robotics Society
Contact: Ted Griebling, president
Email: president@seattlerobotics.org, erich@seanet.com
URL: www.seattlerobotics.org/
Meetings: 3rd Saturday of every month
Renton Technical College, Room J314
10 AM-12 Noon.
Address: Seattle Robotics Society
P.O. Box 1714
Duvall, WA 98019-1714
Telephone:

City & State:
Group Name: The Robotics Club of Yahoo (TRCY)
Contact: Justin Ratliff, president
Email: Weyoun7@aol.com
URL: members.tripod.com/RoBoJRR
Meetings: Weekly chat session every Wednesday
around 9 PM EST and ending around 11:30 PM
Address:
Telephone:

Ray Marston describes the basic operating principles and applications of a variety of light-sensitive devices.



LDR BASICS

Electronic optosensors are devices that alter their electrical characteristics in the presence of visible or invisible light. The best known devices of these types are the LDR (light dependent resistor), the photodiode, the phototransistor, and the PIR (passive infrared) detector.

LDR operation relies on the fact that the conductive resistance of a film of cadmium sulphide (CdS) varies with the intensity of light falling on the face of the film. This resistance is very high under dark conditions and low under bright conditions.

Figure 1 shows the LDR's circuit symbol and basic construction, which consists of a pair of metal film contacts separated by a snake-like track of light-sensitive cadmium sulphide film, which is designed to provide the maximum possible contact area with the two metal films. The structure is housed in a clear plastic or resin case, to provide free access to external light.

Practical LDRs are available in a variety of sizes and package styles, the most popular size having a face diameter of roughly 10mm. *Figure 2* shows the typical characteristic curve of such a device, which has a resistance of about 900R at a light intensity of 100 Lux (typical of a well-lit room) or about 30R at an intensity of 8000 Lux (typical of bright sunlight). The resistance rises to several megohms under dark conditions.

LDRs are sensitive, inexpensive, and readily available devices with power and voltage handling capabilities similar to those of conventional resistors. Their only significant defect is that they are fairly slow acting, taking tens or hundreds of milliseconds to respond to sudden changes in light level.

Useful LDR applications include light- and dark-activated switches and alarms, and *Figures 3* to *9* show some practical circuits of these types; each of these circuits will work with virtually any LDR with a face diameter in the range of 3mm to 12mm.

LDR LIGHT-SWITCHES

Figures 3 to *5* show some practical relay-output light-activated switch circuits based on the LDR. *Figure 3* shows a simple non-latching circuit, designed to activate when light enters a normally-dark area, such as the inside of a safe or cabinet, etc.

Here, R1-LDR and R2 form a potential divider that controls the base-bias of Q1. Under dark conditions, the LDR resistance is very high, so negligible base-bias is applied to Q1, and Q1 and RLA are off. When a significant amount of light falls on the LDR face, the LDR resistance falls to a fairly low value and base-bias is applied to Q1, which thus turns on and activates the RLA/1 relay contacts, which can be used to control external circuitry. The relay can be any 12V type with a coil resistance of 180R or greater.

The simple *Figure 3* circuit has a fairly low sensitivity, has no facility for sensitivity adjustment, and its light trigger points vary with variations in circuit supply voltage and ambient temperature. *Figure 4* shows a very sensitive, precision light-activated circuit that suffers from none of these weaknesses.

Here, LDR-RV1 and R1-R2 are connected in the form of a Wheatstone bridge, and the op-amp and Q1-RLA act as a sensitive balance-detecting switch. The bridge balance point is quite independent of variations in supply voltage and temperature, and is influenced only by variations in the relative values of the bridge components.

In *Figure 4*, the LDR and RV1 form one arm of the bridge, and R1-R2 form the other arm. These arms act as potential dividers, with the R1-R2 arm applying a fixed half-supply voltage to the non-inverting input of the op-amp, and with the LDR-RV1 divider applying a light-dependent variable voltage to the inverting terminal of the op-amp.

In use, RV1 is adjusted so that the LDR-RV1 voltage rises slightly above that of R1-R2 as the light intensity rises to the desired trigger level and, under this condition, the op-amp output switches to negative saturation and drives the relay on via Q1 and biasing resistors R3-R4.

When the light intensity falls below this level, the op-amp output switches to positive saturation and, under this condition, Q1 and the relay are off.

The *Figure 4* circuit is very sensitive and can detect light-level changes too small to be seen by the human eye. The circuit can be modified to act as a precision dark-activated switch by either transposing the inverting and non-inverting input terminals of the op-amp, or by transposing RV1 and the LDR.

Figure 5 shows a circuit using the latter option; this circuit also shows how a small amount of hysteresis can be added to the circuit via feedback resistor R5, so that the relay turns on when the light level falls to a particular value, but does not turn off again until the light intensity rises a substantial amount above this value. The magnitude of hysteresis is inversely proportional to the R5 value, being zero when R5 is open circuit.

A BELL-OUTPUT LDR ALARM

The *Figure 3* to *5* light-activated LDR circuits all have relay outputs that can be used to control virtually any type of external circuitry. In some light-activated applications, however, circuits are required to act as

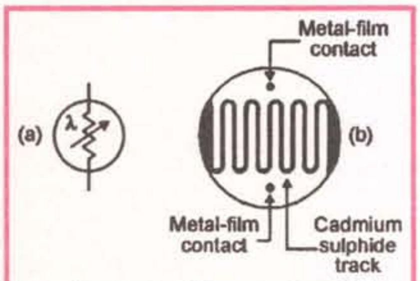


Figure 1. **LDR symbol (a) and basic structure (b).**

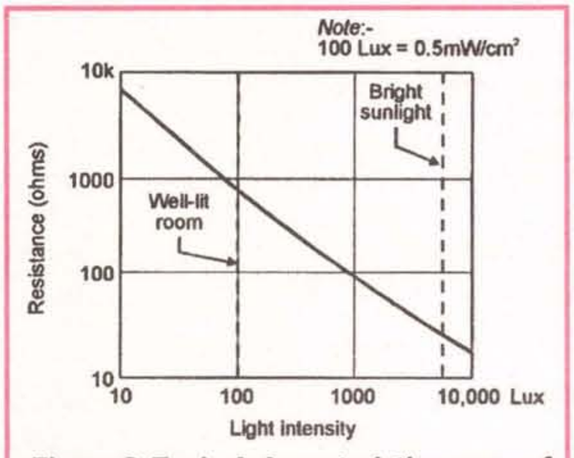


Figure 2. **Typical characteristics curve of a LDR with a 10 mm face diameter.**

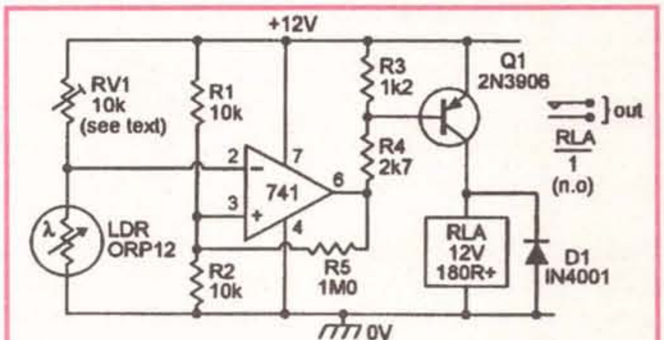


Figure 5. **Precision dark-activated switch, with hysteresis.**

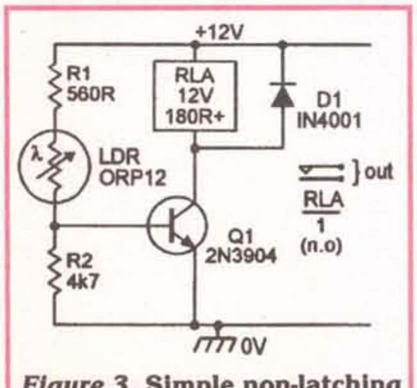


Figure 3. **Simple non-latching light-activated relay switch.**

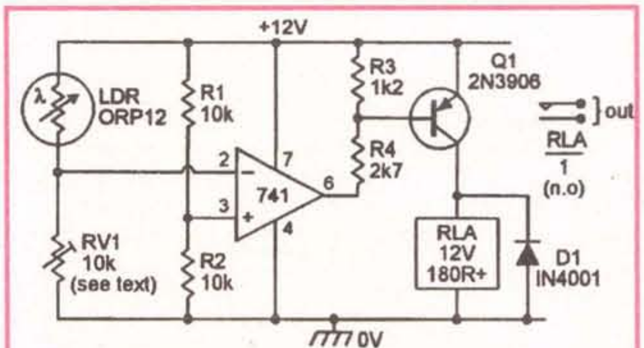


Figure 4. **Precision light-sensitive relay switch.**

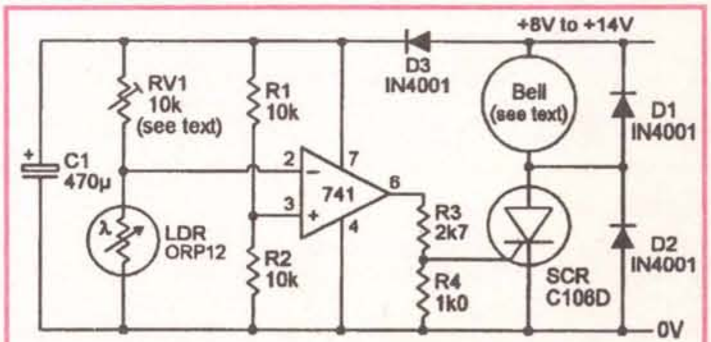


Figure 6. **Precision light-activated alarm bell.**

audible-output alarms, with a bell or siren-sound output, and this type of action can be obtained without the use of relays.

Figure 6 shows a practical 'alarm bell output' circuit that gives a direct output to an alarm bell, which must be of the self-interrupting type that consumes an operating current of less than 2A. The circuit's supply voltage should be 1.5V to 2V greater than the nominal operating value of the bell.

The *Figure 6* circuit uses a Wheatstone bridge (LDR-RV1-R1-R2) and an op-amp balance detector to give the precision sensing/switching action (as described in the basic *Figure 4* circuit), but its output drives the alarm bell via an inexpensive SCR; the basic circuit can be converted into a dark-activated alarm by simply transposing RV1 and the LDR; hysteresis can also be added, if required.

Note in the *Figure 6* circuit that, although the SCR is a self-latching device, the fact that the bell is of the self-interrupting type ensures that the SCR automatically unlatches repeatedly as the bell operates (and the SCR anode current falls to zero in each self-interrupt phase). Consequently, the alarm bell automatically turns off again when the light level falls back below the trip level.

SIREN-OUTPUT LDR ALARMS

Figures 7 to *9* show ways of using CMOS 4001B quad two-input NOR gate ICs as the basis of various light-activated 'siren-sound' alarms that generate audible outputs in loudspeakers.

The *Figure 7* circuit is that of a light-activated alarm that generates a low-power (up to 520mW) 800Hz pulsed-tone signal in the speaker when the light input exceeds a pre-set threshold value.

Here, IC1c and IC1d are wired as a 800Hz astable multivibrator that can feed tone signals into the speaker via Q1 and is gated on only when the output of IC1b is low, and IC1a-IC1b are wired as a 6Hz astable that is gated on only when its pin-1 gate terminal (which is coupled to the LDR-RV1 potential divider) is pulled low.

The action of the *Figure 7* circuit is as follows. Under dark conditions, the LDR-RV1 junction voltage is high, so both astables are disabled and no signal is generated in the speaker. Under 'light' conditions, the LDR-RV1 junction voltage is low, so the 6Hz astable is activated and, in turn, gates the 800Hz astable on and off at a 6Hz rate, thereby generating a pulsed-tone signal in the speaker via Q1.

The precise switching or gate point of the 4001B IC is determined by the threshold voltage value of the IC, and this is a percentage value of the supply voltage: the value is nominally 50%, but may vary from 30% to 70% between individual ICs. In practice, the switching point of each individual 4001B IC is very stable, and the *Figure 7* circuit gives very sensitive 'light'-activated alarm triggering.

Figure 8 shows the circuit of a self-latching, light-activated alarm with an 800Hz monotone output. In this case, IC1c-IC1d are again wired as a gated 800Hz astable, but IC1a-IC1b are wired as a bistable multivibrator with an output that (under dark conditions) is normally high, thus gating the 800Hz astable off.

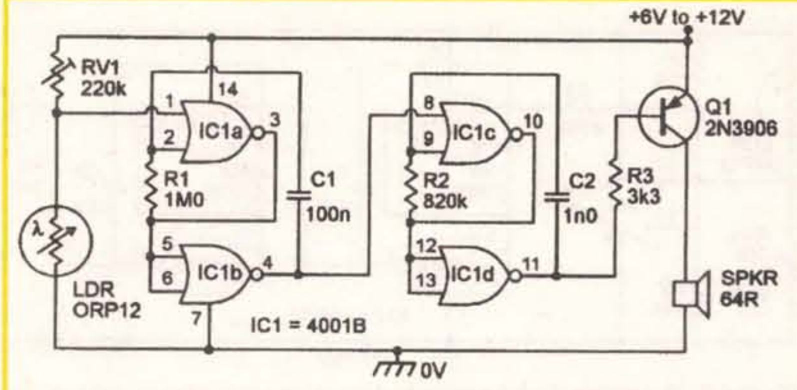


Figure 7. **Light-activated alarm with pulsed-tone output.**

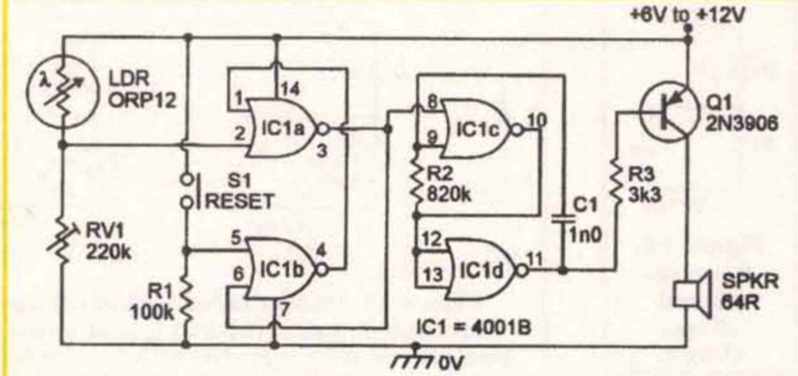


Figure 8. **Self-latching light-activated alarm with monotone output.**

Under bright conditions, however, the LDR-RV1 junction goes high and latches the bistable into its alternative 'output low' state, thereby gating the 800Hz astable on and generating the monotone alarm signal; once latched, the circuit remains in this 'on' state until dark conditions return and the

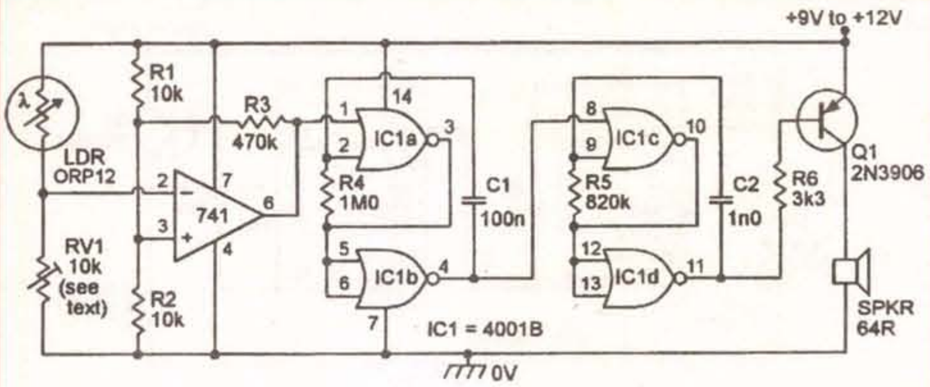


Figure 9. Precision light-activated pulsed-tone alarm with hysteresis.

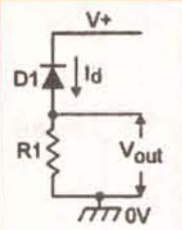


Figure 10. Reverse-biased diode circuit.

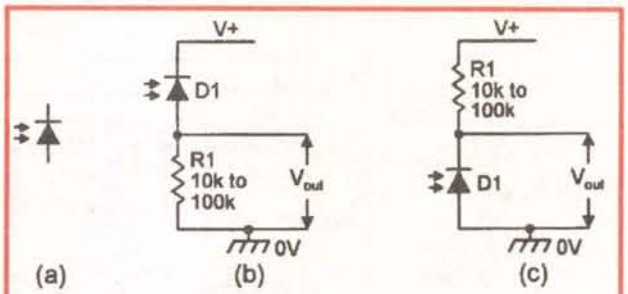


Figure 11. Photodiode symbol (a) and alternative ways ((b) and (c)) of using a photodiode as a light-to-voltage converter.

bistable is simultaneously reset via S1.

Note that the light/dark operation of the *Figure 7* and *8* circuits can be reversed by simply transposing the LDR-RV1 positions. The sensitivity levels of these two basic circuits are adequate for most practical purposes, but can, if required, be boosted (and the trigger-level stability increased), by interposing an op-amp voltage comparator (of the basic *Figure 4* or *5* type) between the LDR-RV1 light-sensitive potential divider and the gate terminal of the CMOS waveform generator, as shown in the *Figure 9* circuit; resistor R3 controls the hysteresis of the circuit, and can be removed if the hysteresis is not needed.

The *Figure 7* to *9* circuits generate fairly modest values of acoustic output power, with the power input to the 64-ohm loudspeaker reaching a maximum value of 520mW when using a 12V supply. The available output power can, however, easily be boosted by feeding the circuit's output to low-impedance horn-type loudspeakers via simple power-boosting amplifiers.

PHOTODIODES

Cadmium sulphide (CdS) LDRs are sensitive but slow-acting devices. They are ideal for use in slow-acting, direct-coupled light-level sensing applications, but are not suitable for use as optical sensors in medium- to high-speed applications. The ideal optical sensors for use in the latter applications are the silicon photodiode and the silicon phototransistor.

In its very crudest form, a photodiode is a normal silicon diode minus its opaque (light-excluding) covering. If a normal silicon diode is connected in the reverse-biased circuit of *Figure 10*, negligible current flows through the diode and zero voltage is developed across R1.

If the diode's opaque covering is now removed (so that the diode's semiconductor junction is revealed) and the junction is then exposed to visible light in the same circuit, the diode will pass a significant reverse current and thus generate an output voltage across R1.

The magnitude of the reverse current and the output voltage is directly proportional to the intensity of the light source, and the diode is thus truly photosensitive.

All silicon junctions are photosensitive, and a basic photodiode can — for most practical purposes — be regarded as a normal diode housed in a case that lets external light easily reach its photosensitive semiconductor junction. *Figure 11(a)* shows the standard photodiode symbol.

In use, the photodiode is reverse-biased and the output voltage is taken from across a series-connected load resistor; this resistor can be connected between the diode and ground, as in *Figure 11(b)*, or between the diode and the positive supply line, as in *Figure 11(c)*.

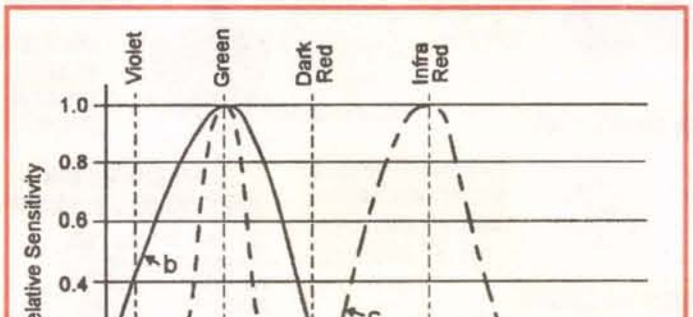


Figure 13. Typical spectral response curves of (a) the human eye and (b) general-purpose and (c) IR photodiodes.

In reality, the physical form of a normal silicon diode's *pn* junction is such that the device exhibits fairly low optical sensitivity; all practical photodiodes use special types of junction design, to maximize their effective photosensitivity. Most photodiodes come in one or the other of two basic types, being either 'simple' photodiodes or PIN photodiodes. *Figure 12* illustrates some basic points on these subjects.

Normal silicon junction diodes use the basic form of construction shown (in symbolic form) in *Figure 12(a)*, in which the device's *p*- and *n*-type materials are moderately thick (and thus fairly opaque), and are effectively fused directly together to form the device's junction; the relatively high opacity of the *pn* junction's materials gives the junction fairly poor photosensitivity.

In a simple photodiode, the photosensitivity is greatly increased by using a very thin (and thus highly translucent) slice of material on the *p*-type side of the junction, as shown in *Figure 12(b)*; external light can be applied, via a built-in lens or window, to the opto-sensitive *pn* junction via this thin slice of *p*-type material.

Simple *Figure 12(b)*-type photodiodes have minimum on/off switching times of about 1µS, and can thus be used at maximum pulsed or switched operating frequencies of about 300kHz.

The prime cause of this relatively long switching time is the high capacitance that occurs at the device's junction, between the *p*- and *n*-type materials. This problem is greatly reduced in PIN photodiodes, in which a very thin slice of intrinsic ('I') or 'undoped' silicon material is interposed at the junction between the *p*- and *n*-type materials, as shown in *Figure 12(c)*, thus greatly reducing the *p*-to-*n* junction's capacitance value.

Modern PIN-type photodiodes have typical minimum on/off switching times of about 10nS, and can thus be used at maximum switched-mode operating frequencies of about 30MHz, which is adequate for the vast majority of practical optoelectronic applications (in cases where even higher switching frequency optical sensing is required, special ultra-high-frequency avalanche-type photodiodes can be used).

Photodiodes can be designed to respond to either visible light or to IR light. The human eye has the type of spectral response curve shown in curve '*a*' in *Figure 13*. It has a maximum sensitivity to the color green, which has a wavelength of about 550nm, but has a low sensitivity to violet (400nm) at one end of the spectrum and to dark red (700nm) at the other.

General-purpose visible-light photodiodes have typical spectral response characteristics like those shown in curve '*b*' in *Figure 13*, and infrared (IR) types have the type of response shown in curve '*c*.'

PHOTOTRANSISTORS

Ordinary silicon transistors are made from an npn or pnp sandwich, and thus inherently contain a pair of photosensitive junctions. Some types are available in phototransistor form, and use the standard symbol shown in *Figure 14(a)*.

Figures 14(b) to *14(d)* show three basic ways of using a phototransistor; in each case, the base-collector junction is effectively reverse-biased and thus acts as a photodiode.

In *(b)*, the base is grounded, and the transistor acts as a simple photodiode. In *(c)* and *(d)*, the base terminal is open-circuit and the photo-generated currents effectively feed directly into the base and, by normal transistor action, generate a greatly amplified collector-to-emitter current that produces an output voltage across series resistor R1.

The sensitivity of a phototransistor is typically one hundred times greater than that of a photodiode, but its useful maximum operating frequency (usually a few hundred kHz) is proportionally lower than that of a photo-

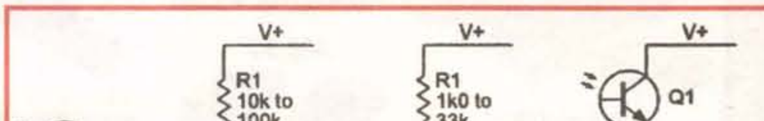


Figure 12. Symbol and basic construction of (a) a normal silicon junction diode, (b) a simple photodiode, and (c) a PIN photodiode.

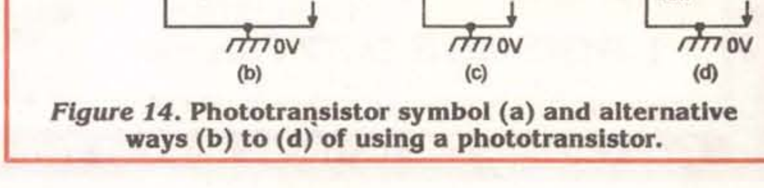


Figure 14. Phototransistor symbol (a) and alternative ways (b) to (d) of using a phototransistor.

diode.

Most phototransistors are manufactured in two-pin form, with only the device's collector and emitter made externally available; three-pin types can be used in any of the basic configurations shown in *Figure 14*. Some phototransistors are made in very-high-gain Darlington form.

Note in the *Figure 11* and *14* photodiode and phototransistor circuits that, in practice, the R1 load value is usually chosen on a compromise basis, since the circuit sensitivity increases but the useful operating bandwidth decreases as the R1 value is increased. Also, the R1 value must, in many applications, be chosen to bring the photosensitive device into its linear operating region.

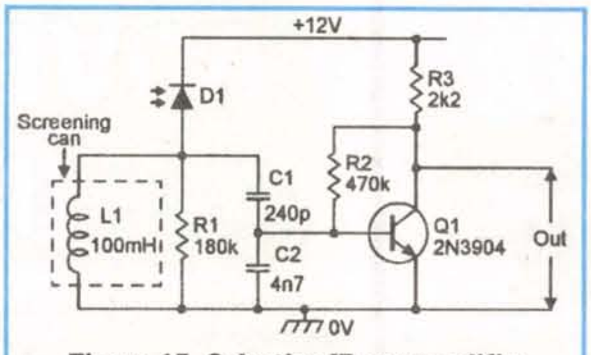


Figure 15. **Selective IR pre-amplifier designed for 30kHz operation.**

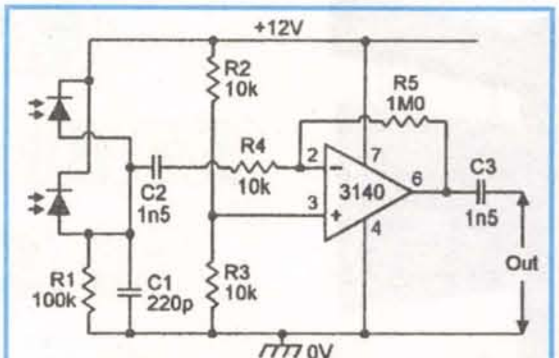


Figure 16. **20kHz selective pre-amp for use in IR lightbeam applications.**

IR PRE-AMP CIRCUITS

Photodiodes or phototransistors are often used as the sensing elements at the receiver end of light-beam alarms, remote control, or fiber optic cable systems. In such applications, the signal reaching the photosensor may vary considerably in strength, and the sensor may be subjected to a great deal of noise in the form of unwanted visible or IR light signals, etc.

To help minimize these problems, the systems are usually operated in the IR range, and the optosensor output is passed to processing circuitry via a low-noise pre-amplifier with a wide dynamic operating range. *Figures 15* and *16* show typical examples of such circuits, using photodiode sensors.

The *Figure 15* circuit is designed to detect an IR optical signal that is switched at a 30kHz rate. Photodiode D1 senses the IR signal and feeds it into 30kHz tuned circuit L1-C1-C2, which is lightly damped by R1. The resulting frequency-selected low-noise output of the tuned circuit is tapped off at the C1-C2 junction and then amplified by Q1.

Figure 16 shows a 20kHz selective pre-amplifier circuit for use in an IR light-beam alarm application, in which the alarm sounds when the beam is broken. Here, two IR photodiodes are wired in parallel (so that beam signals are lost only when *both* diode signals are cut off) and share a common 100k load resistor (R1). R1 is shunted by C1 to reject unwanted high-frequency signals, and its output is fed to the x100 op-amp inverting amplifier via C2, which rejects unwanted low-frequency signals.

PIR MOVEMENT-DETECTING SYSTEMS

IR light-beam alarms are active IR units that react to an artificially-generated source of IR radiation. Passive IR (PIR) alarms, on the other hand, react to naturally generated IR radiation such as the heat-generated IR energy radiated by the human body, and are widely used in modern security systems.

Most PIR security systems are designed to activate an alarm or floodlight, or open a door or activate some other mechanism, when a human or other large warm-blooded animal moves about within the sensing range of a PIR detector unit, and use a pyroelectric IR detector of the type shown in *Figure 17* as their basic IR-sensing element.

The basic *Figure 17* pyroelectric IR detector makes use of special ceramic elements that generate electrical charges when subjected to thermal variations or uneven heating.

Modern pyroelectric IR detectors — such as the popular PIS201S and E600STO types — incorporate two small opposite-polarity series-connected ceramic elements of this type, with their combined output buffered via a JFET source-follower, and have the IR input signals focused onto the ceramic elements by a simple filtering lens, as shown in the basic PIR detector usage circuit of *Figure 17*.

It is important to note at this point that the detector's final output voltage is proportional to the *difference* between the output voltages of the two ceramic elements.

The basic action of the *Figure 17* PIR detector is such that, when a human body is within the visual field of the pyroelectric elements, part of that body's radiated IR energy falls on the surfaces of the elements and is converted into small but detectable variations in surface temperature and corresponding variations in the output voltage of each element.

If the human body (or other source of IR radiation) is stationary in front of the detector's lens under this condition, the two elements generate identical output voltages and the unit's final 'difference' output is thus zero, but if the body is moving while in front of the lens, the two elements generate different output voltages and the unit produces a varying output voltage.

Thus, when the PIR unit is wired as shown in the *Figure 17* basic usage circuit, this movement-inspired voltage variation is made externally available via the buffering JFET and DC-blocking capacitor C1 and can — when suitably amplified and filtered — be used to activate an alarm or other mechanism when a human body movement is detected.

In practice, pyro-electric IR detectors of the simple type just described have — because of the small size (usually about $20mm^2$) and simple design of the detector's IR-gathering lens — maximum useful detection ranges of roughly one meter. In modern commercial PIR movement detecting security units, however, this range is usually extended to at least 10 meters with the aid of a large (about $2000mm^2$) multi-faceted external IR-gathering/focusing plastic lens, which splits the visual field into a number of parallel strips and focuses them onto the two sensing areas of the PIR unit.

Figure 18 shows the typical PIR sensing pattern of a commercial 'intrusion detector' unit designed to protect a normal-sized room in domestic-type applications. In this example, the unit is mounted on a wall at a height of seven feet and is aimed downwards at a shallow angle, and the multi-faceted plastic lens splits the visual field into a large number of vertical and horizontal segments.

Any person moving through a single segment will activate a single trigger signal within the PIR sensor; a person moving through the entire visual field thus produces numerous triggering signals, but a stationary IR source produces no signals.

Most intrusion detectors of this type incorporate 'event counting' circuitry that will only generate an alarm-activating output if three or more trigger signals are detected within a few seconds, thus minimizing the chances of a false alarm due to sudden changes in temperature caused by the auto-activation of time-switched security lights, etc.

The lens-generated PIR sensor pattern shown in *Figure 18* is the type usually used to protect single rooms in domestic burglar-alarm systems.

Alternative lenses offer different ranges and coverage patterns for various special types of application; amongst these are the 'pet' type, in which the field's vertical span is restricted to 2.5 to 6.6 feet above ground level to avoid activation by domestic pets while giving good sensitivity to normal humans, and the 'corridor' type, in which the field's horizontal span is restricted to about 20 degrees to give long-distance coverage (typically about 30 meters) of narrow corridors and passageways.

Note that, because high-quality commercial PIR security units of this basic type are widely available at comparatively low cost, it is not practicable (on aesthetic and cost-effective grounds) to try to build similar units on a DIY basis. **NV**

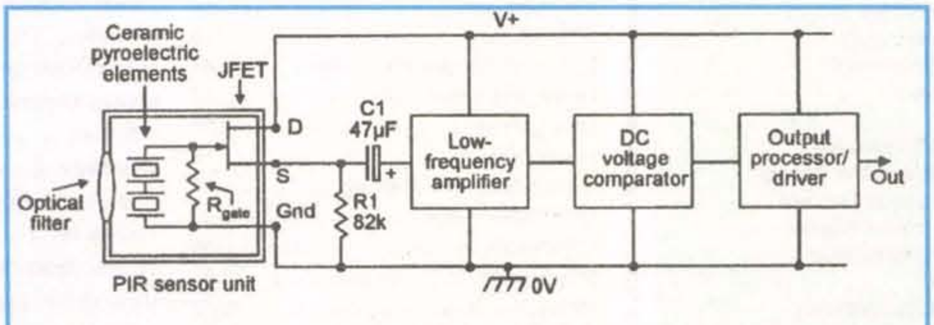


Figure 17. **Basic PIR detector usage circuit.**

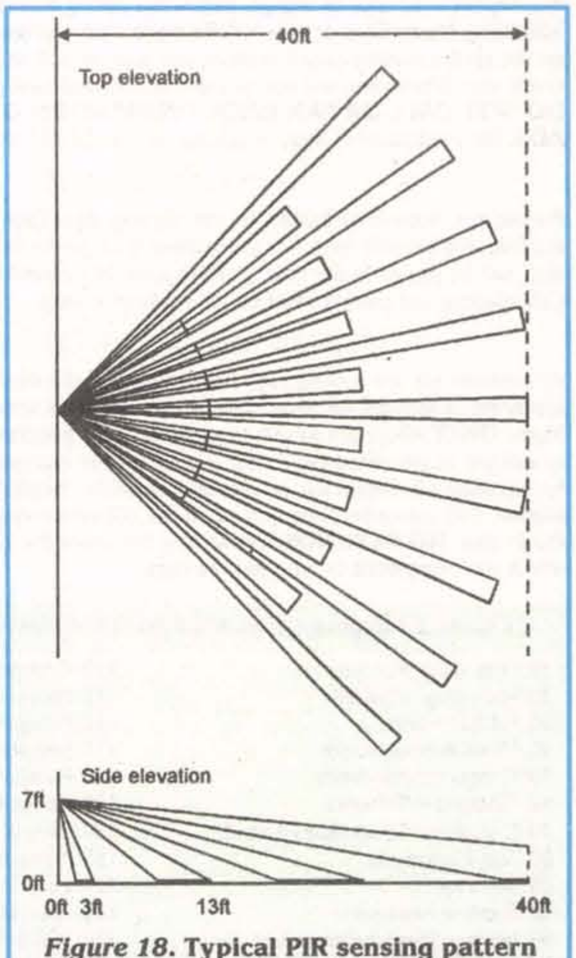
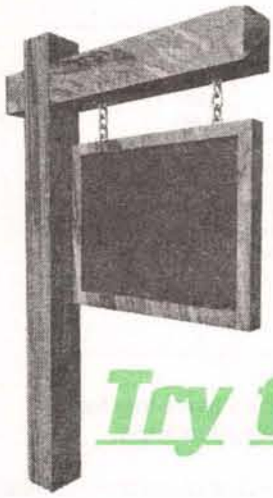


Figure 18. **Typical PIR sensing pattern of a commercial 'intrusion detector' unit designed for normal domestic-type applications.**



Got something to sell?

Try the classifieds!!

TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY (not all caps)** on a separate piece of paper. Spell out words when submitting handwritten copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for **bold** and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. **Enclose your name, address, phone number, and *Nuts & Volts* account number from your mailing label** (if available) for identification purposes. Include full payment — **CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY** — and mail your completed order to:
NUTS & VOLTS MAGAZINE, 430 Princeland Ct., Corona, CA 92879.

RATE PER WORD

The ad rate for **current PAID subscribers** is **60¢** per word. All others pay **$1.20** per word. There is a **$9.00 minimum** charge per ad per insertion.

WORDS IN BOLD AND/OR ALL CAPS

Words to be set in **bold** or CAPS are each 10¢ extra PER WORD. **BOLD CAPS** are 20¢ extra per word. The first two words of each ad are bold capped at no charge. Indicate bold words by underlining. Words normally written in caps (e.g., IBM) and accepted abbreviations such as VAC or MHz are NOT charged as all cap words. Use a two-letter abbreviation for states.

PHOTOS, DRAWINGS, AND BOXES

A photo or drawing may be run at the top of your classified ad for an additional **$10.00** (1" depth max.) for camera-ready art. No wording is allowed in this area. To **BOX** your ad, include an additional **$50.00** for copy-only ads, or **$75.00** for ads with art or photos.

FAXING IN AD COPY

You may fax in ad copy or changes before the closing date (5:00pm on the **5th**) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

DEADLINE

Prepaid ads received by 5:00pm on the **closing date (5th of the month)** will appear in the following month's issue. Ads postmarked through the **5th**, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 5th. Cancellations and changes must be submitted in writing.

IMPORTANT INFORMATION

All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. **NO REFUNDS**. Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your ad copy.

Choose a category for your ad from the classifications listed below.

10. Ham Gear For Sale
20. Ham Gear Wanted
30. CB/Scanners
40. Music & Accessories
50. Computer Hardware
60. Computer Software
70. Computer Equipment Wanted
80. Test Equipment
85. Security
90. Satellite Equipment
95. Military Surplus Electronics
100. Audio/Video/Lasers
110. Cable TV
115. Telephone/Fax
120. Components
125. Microcontrollers
130. Antique Electronics
135. Aviation Electronics
140. Publications
145. Robotics
150. Plans/Kits/Schematics
155. Manuals/Schematics Wanted
160. Misc. Electronics For Sale
170. Misc. Electronics Wanted
175. BBS & Online Services
180. Education
190. Business Opportunities
200. Repairs/Service

ADVERTISER INDEX

Find what you need *FAST* by Product or Category

DEALER DIRECTORY

The dealers listed below carry the latest issue of Nuts & Volts, for your convenience.

ALABAMA

Little Professor Book Center
2717 S. 18th St.
Birmingham 35209

RT Systems
Amateur Radio Supply
8207 Stephanie Dr.
Huntsville 35802

ARIZONA

Batteries Plus #330
3014 N. Dobson
Chandler 85224

Batteries Plus #334
1155 S. Power Rd. #108
Mesa 85206

Batteries Plus #331
2404 E. Bell Rd.
Phoenix 85032

Batteries Plus #332
3415 W. Glendale Ave. Ste. 4
Phoenix 85051

Batteries Plus #333
1829 E. Southern Ave.
Tempe 85282

Elliott Electronic Supply
1251 S. Tyndall Ave.
Tucson 85713

Power Quality, Inc.
642 E. 39th Pl. Ste. 5
Yuma 85365

Tower Records
3 E. 9th St.
Tempe 85281

AUSTRALIA

DonTronics
P.O. Box 595
29 Ellesmere Cres.
Tullamarine 3043
www.dontronics.com

CALIFORNIA

Abletronics
9155 Archibald Ave. Unit E
Cucamonga 91730

Advanced Computer Products, Inc.
1310 "B" E. Edinger Ave.
Santa Ana 92705

All Electronics
905 S. Vermont Ave.
Los Angeles 90006

14928 Oxnard St.
Van Nuys 91411

Alltronics
2300-D Zanker Rd.
San Jose 95131

Centerfold International
716 N. Fairfax Ave.
Los Angeles 90046

Del Amo Books & News
3758 Sepulveda Blvd.
Torrance 90505

Electro Mavin
2985 E. Harcourt St.
Rancho Dominguez 90221

Ford Electronics
8431 Commonwealth Ave.
Buena Park 90621

Harding Way News
113 W. Harding Way
Stockton 95204

Harold's Newsstand
524 Geary St.
San Francisco 94102

Hi-Fi Doctor
1814 E. Ball Rd.
Anaheim 92805

HSC Electronic Supply
4837 Amber Ln.
Sacramento 95841

3500 Ryder St.
Santa Clara 95051

5681 Redwood Dr.
Rohnert Park 94928

Hyatt Electronic Surplus
371 N. Johnson Ave.
El Cajon 92020

JK Electronics
6395 Westminster Ave.
Westminster 92683

Laurel Park News
4346 Laurel Canyon Blvd.
Studio City 91604

Len's Electronic Parts
14410 E. Valley Blvd.
Industry 91746

Len's Electronic Parts
108 W. 25th St. #D
National City 91950

Lion Electronic Labs
4948 E. Townsend Ave.
Fresno 93727

Netseller
7207 Arlington Ave. Ste. G
Riverside 92503

Op Amp Technical Books
1033 N. Sycamore Ave.
Los Angeles 90038

Panorama Electronics
8761 Van Nuys Blvd.
Panorama City 91402

Sandy's Electronics Supply, Inc.
20655 Soledad Cyn. Rd. #15
Santa Clarita 91351

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove 92643

Sierra Madre Newsstand
55 N. Baldwin Ave.
Sierra Madre 91024

The Red Barn
Hwy. 299
Bieber 96009

Tower Books
211 Main St.
Chico 95928

7840 Macy Plaza Dr.
Citrus Heights 95610

1280 E. Willow Pass Rd.
Concord 94520

630 San Antonio Rd.
Mountain View 94040

1600 Broadway
Sacramento 95818

2538 Watt Ave.
Sacramento 95821

Tower Records/Video
220 N. Beach Blvd.
Anaheim 92801

5703 Christie Ave.
Emeryville 94608

6310 E. Pacific Coast Hwy.
Long Beach 90803

3205 20th Ave.
San Francisco 94132

2525 Jones St.
San Francisco 94133

871 Blossom Hill Rd.
San Jose 95123

Video Electronics
3829 University Ave.
San Diego 92105

CANADA

ACE Electronics
501 Linwell Rd.
St. Catherines, ON L2M 2R2

Cody Books Ltd.
139-3000 Lougheed Hwy.
Westwood Mall
Port Coquitlam, BC V3B 1C5

Com-West Radio Systems Ltd.
8206 Ontario St. #100
Vancouver, BC V5X 3E3

Emma Marion Ltd.
2677 E. Hastings St.
Vancouver, BC V5K 1Z5

Muir Communications Ltd.
3214 Douglas St.
Victoria, BC V8Z 3K6

COLORADO

Tower Records/Video
2500 E. 1st Ave.
Denver 80206

CONNECTICUT

Archway News
64 Bank St.
New Milford 06776

Electronic Service Products
437 Washington Ave.
North Haven 06473

DELAWARE

Newark Newsstand
70 E. Main St.
Newark 19711

DISTRICT OF COLUMBIA

Tower Records
2000 Pennsylvania Ave.
Washington 20006

FLORIDA

Alfa Electronic Supply
1502 S. St. Rd. #7
Hollywood 33023

Al's News
8219 S.W. 124th St.
Miami 33156

Astro Too
2854 Sarno Rd.
Melbourne 32935

Clarks Out of Town News
303 S. Andrews Ave.
Fort Lauderdale 33301

Mike's Electronic Distributing Co.
1001 N.W. 52nd St.
Fort Lauderdale 33309

Skycraft Parts & Surplus, Inc.
2245 W. Fairbanks
Winter Park 32789

Sunny's At Sunset, Inc.
8260 Sunset Strip
Sunrise 33322

GEORGIA

Tower Records
3400 Around Lenox Dr. N.E.
Atlanta 30326

HAWAII

SolarWorks!
525 Lotus Blossom Ln.
Ocean View 96737

Tower Records
4211 Waialae Ave.
Honolulu 96816

611 Keeaumoku
Honolulu 96814

IDAHO

The Current Source
5159 Glenwood
Boise 83714

ILLINOIS

Tower Records/Video/Books
383 W. Army Trail Rd.
Bloomingdale 60108

2301 N. Clark St. #200
Chicago 60614

1209 E. Golf Rd.
Schaumburg 60173

INDIANA

Harbourtown Sales
108 Park 32 W. Dr.
Noblesville 46060

KANSAS

Hollywood At Home
9063 Metcalf Ave.
Overland Park 66212

Lloyd's Radio & Electronic, Inc.
220 W. Harry St.
Wichita 67213

LOUISIANA

Lakeside News
3323 Severn Ave.
Metairie 70002

MARYLAND

Tower Records/Video
2566 Solomons Island Rd.
Annapolis 21401

1601 Rockville Pike #210
Rockville 20852

MASSACHUSETTS

Newsbreak, Inc.
579 G.A.R. Hwy. Rt. 6
Swansea 02777

MICHIGAN

Little Professors Book Center
22174 Michigan Ave.
Dearborn 48124

Purchase Radio Supply, Inc.
327 E. Hoover Ave.
Ann Arbor 48104

MINNESOTA

Radio City, Inc.
2633 County Road 1
Mounds View 55112

MISSOURI

Accurate Instruments
11201 E. 24 Hwy.
Independence 64054

Electronics Exchange
8644 St. Charles Rock Rd.
St. Louis 63114

NEVADA

Amateur Electronic Supply
1072 N. Rancho Dr.
Las Vegas 89106

Less Buster's Electronics
2930 N. Las Vegas Blvd.
VSTG-22
North Las Vegas 89030

Radio World
1656 Nevada Hwy.
Boulder City 89005

Tower Records/Video
4580 W. Sahara Ave.
Las Vegas 89102

6450 S. Virginia
Reno 89511

NEW YORK

All Phase Video Security, Inc.
70 Cain Dr.
Brentwood 11717

Computer Warehouse
137 E. Bridge St.
Oswego 13126

Ham Central
3 Neptune Rd.
Poughkeepsie 12601

Hirsch Sales Corporation
219 California Dr.
Williamsville 14221

Tower Records/Video
105 Old Country Rd.
Carle Place 11514

350-370 Route 110
Huntington 11746

1961 Broadway
New York 10023

383 Lafayette St.
New York 10003

OHIO

Bank News
4025 Clark Ave.
Cleveland 44109

Compustuff
241 Great Oaks Trl.
Wadsworth 44281

Footsteps
4925 Jackman Rd. Store #58
Toledo 43613

Hosfelt Electronics, Inc.
2700 Sunset Blvd.
Steubenville 43952

Keyways, Inc.
204 S. 3rd St.
Miamisburg 45342

Leo's Book Shop
333 N. Superior St.
Toledo 43604

Powermaxx, Inc.
1587 U.S. Route 68 N.
Xenia 45385

OKLAHOMA

Steve's Books & Magazines
2612 S. Harvard
Tulsa 74114

Taylor News & Books
133 W. Main, Ste. 102
Oklahoma City 73102

OREGON

News & Smokes
2295 W. Main St.
Medford 97501

Norvac Electronics
7940 S.W. Nimbus Ave. Bldg. 8
Beaverton 97005

960 Conger
Eugene 97402

1545 N. Commercial N.E.
Salem 97303

Tower Books
1307 N.E. 102nd Ave.
Portland 97220

PENNSYLVANIA

Bedford St. News
308 Bedford St.
Johnstown 15901

Lehman Scientific
2997 F. Cape Horn Rd.
Red Lion 17356

Tower Books
425 South St.
Philadelphia 19147

Tower Records
340 W. Dekalb Pike
King of Prussia 19406

SOUTH CAROLINA

555 Electronics
5646 Farrow Rd.
Columbia 29203

TENNESSEE

Tower Books
2404 W. End Ave.
Nashville 37203

TEXAS

BDL News, Inc.
809 Pierce
Houston 77002

Electronic Parts Outlet
3753-B Fondren Rd.
Houston 77063

Mouser Electronics
958 N. Main St.
Mansfield 76063

Tanner Electronics
1301 W. Beltline #105
Carrollton 75006

Tower Records
2403 Guadalupe St.
Austin 78705

VIRGINIA

American Computer Clearance
1609 Rhoadmiller St.
Richmond 23220

Tower Records/Video/Books
4110 W. Ox Rd. #12124
Fairfax 22033

1601 Willow Lawn Dr.
Richmond 23230

8389 E. Leesburg Pike
Vienna 22182

WASHINGTON

A-B-C Communications, Inc.
17541 15th Ave. N.E.
Seattle 98155

Bohica Concepts
214 2nd St.
Morton 98356

Service Request
3304 W. Rowan Ave.
Spokane 99205

Supertronix
16550 W. Valley Hwy.
Seattle 98188

Tower Books
10635 N.E. 8th St.
Bellevue 98004

20 Mercer St.
Seattle 98109

WISCONSIN

Amateur Electronic Supply, Inc.
5710 W. Good Hope Rd.
Milwaukee 53223

Greenfield News & Hobby
6815 W. Layton Ave.
Greenfield 53220

Cudahy News & Hobby Ctr.
4758 Packard Ave.
Cudahy 53110

WYOMING

Western Test Systems
2701 Westland Ct. #B
Cheyenne 82001

ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware, software, circuits, electronic theory, troubleshooting, and anything else of interest to the hobbyist. Feel free to participate with your questions, as well as comments and suggestions.

You can reach me at:
TJBYERS@aol.com
TJBYERS@juno.com
or by snail mail at
Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 92879.

What's Up:

Lots of **automotive stuff**. Some clues on **magnetic fields** and how they are measured and detected. Fun stuff with **Lissajous patterns** and other **oscilloscope topics**. Finally, in search of **the lost IC** defined. Have a Prosperous New Year!

Windows DLL Sources

Q. I'm trying to write a PIC chip program using Windows and interface hardware, and I need a DLL driver. Unfortunately, I don't know how to write Windows drivers, but I've heard that I don't have to. There are lots of these drivers out there free for the picking, right?

Eric Kirby
via Internet

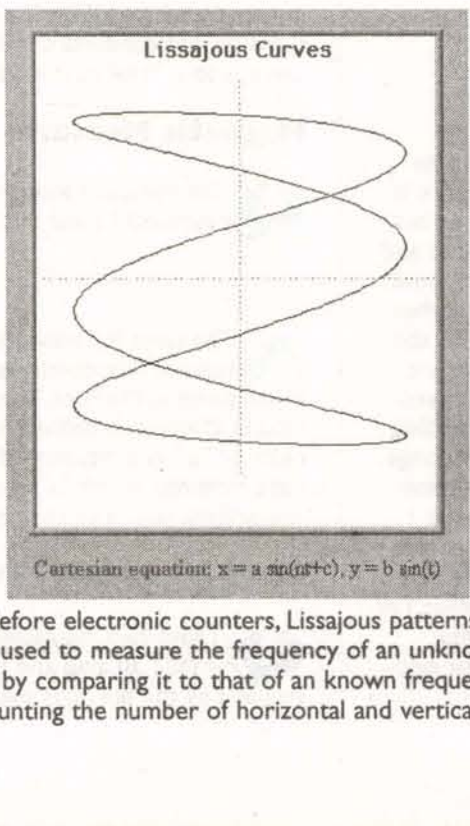
A. Two web sites, **www.driverguide.com** and **www.mrdriver.com**, provide access to many up-to-date drivers needed to control PC hardware. Visit T & M World Online's Cool Web Sites page at **http://www.tmworld.com/articles/links.html** and scroll down to "Software for Download" to access these sites and other useful sites.

Lissajous Reflections

Q. I remember making interesting Lissajous figures in a physics class years ago. Could you explain their uses and how to make them on an oscilloscope?

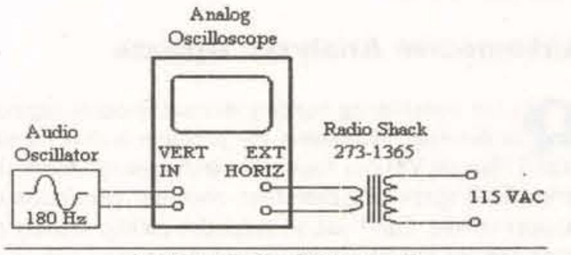
Keith Penner
via Internet

A. A Lissajous pattern is a graph of a curve in which both the x and y Cartesian coordinates are periodic functions of time (t) given by equations — typically, $x = \sin(nt + c)$ and $y = \sin(t)$. Different patterns may be generated for different values of n and c. A Lissajous figure is easily generated on the screen of an oscilloscope by turning off the internal horizontal sweep and applying a sinewave to both the vertical and external horizontal inputs. The shape of the pattern is a function of the frequency ratio and phase angle between the two signals. For example, if the two sine waves are in phase and of the same frequency, the screen displays a circle. A frequency ratio of 2:1 generates a figure eight pattern and a ratio of 3:1 produces three loops, like the one shown below.

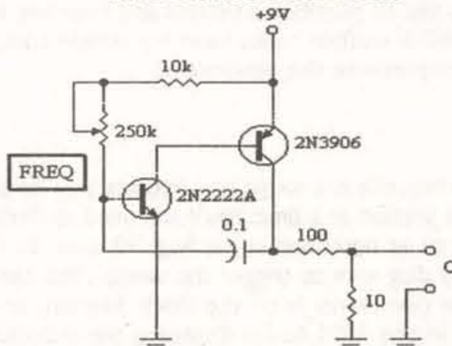


Before electronic counters, Lissajous patterns were often used to measure the frequency of an unknown signal by comparing it to that of an known frequency. By counting the number of horizontal and vertical nodes, complex ratios like 4:5 and 11:9 are easily recognized and the unknown frequency easily calculated. *N & V* published an article on building a Lissajous effects generator ("Artistic Design Generator") that appeared in the May 1993 issue. This issue is still available from our back issue order desk; contact us at 909-371-8497 for details.

However, you don't have to go to this extreme to have fun with Lissajous graphics. All you need is a sinewave oscillator, a 12-volt power transformer, and an analog oscilloscope. That's it! Here's the setup, including the schematic for a very simple audio generator.



SIMPLE AUDIO OSCILLATOR

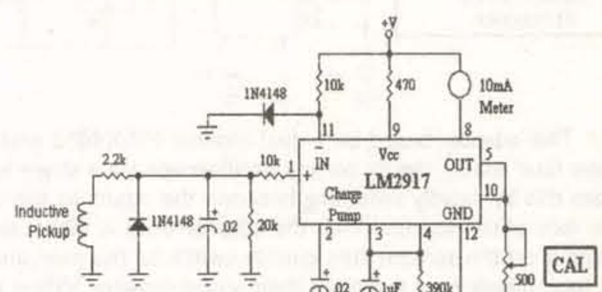


Motorbike Tachometer

Q. I have a motorized bicycle powered by a small two-stroke gasoline engine that I'm having a problem with. It keeps cutting in and out. Is there a circuit (or a commercial product) to tell whether or not the spark is still there when the engine cuts out, thereby indicating a fuel problem? Perhaps some inductive coupling to the spark plug wire? It must be battery powered. The spark is created by an engine driven magneto. I prefer a meter rather than a light because in daylight I can't see indicator lamps too well.

Tony Serra
via Internet

A. How about a tachometer? Not only will it tell you if there's a spark or not, but it'll display the RPM speed of the engine. Here's a simple 12-volt (actually, 8 to 16 volts) circuit built around an LM2917 frequency-to-voltage converter chip.



An inductive pickup made from a 100 uH coil placed next to the spark plug wire feeds one pulse per revolution to the LM2917. SMT (surface mounted) devices are smaller and easier to install. Alternatively, you can try wrapping a few turns of insulated wire around the spark plug wire. Here, you'll have to play it by ear to determine how many turns of wire are needed to trigger the IC. I'd guess 6 to 30 turns, but this will vary according to your engine. Fortunately, you can test the tach circuit to see if it's working before installing the sensor. The signal is then rectified, filtered, and input to the LM2917. Inside the IC is a charge

pump that integrates the pulses into a DC voltage that's directly proportional to the input frequency. From here it's buffered and adjusted (using the CAL control) to drive the current meter for an accurate RPM reading. This step can be eliminated if all you want to do is see if the spark is there or not. The meter is available from **Mouser Electronics (1-800-346-6873; http://www.mouser.com)** for about $15.00 and the IC can be found under the guise of NTE995 (about $3.00) from RadioShack and others if you can't locate the original.

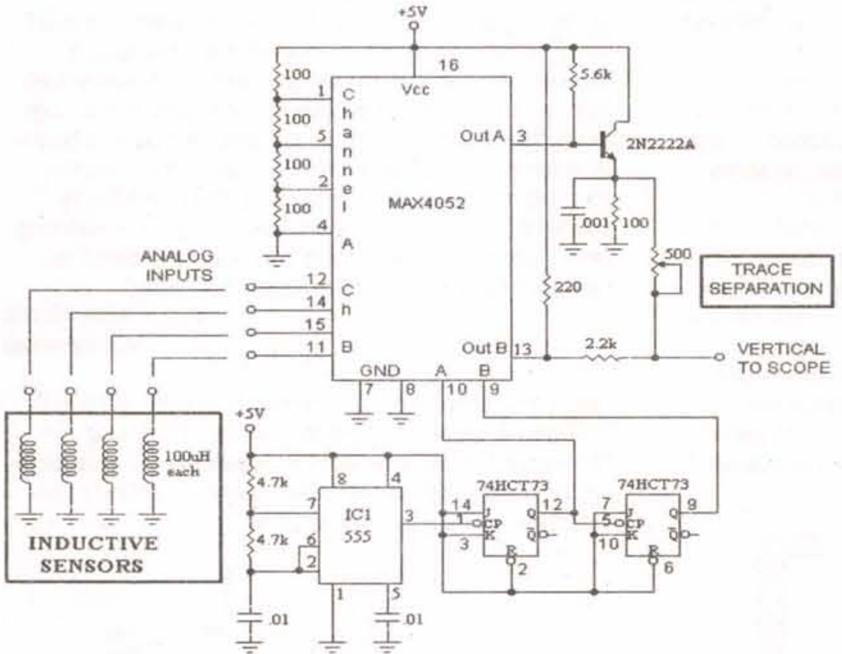
If everything is working properly, the meter will register a speed of 3600 RPM. Use the 500-ohm CAL potentiometer to adjust the pointer needle to your selected scale reading. Now replace the transformer with the sensor coil ... and you're done.

Automotive Analyzer Update

Q. I'm considering building the automotive engine analyzer you described in the Aug. '99 column. My problem is that my vehicle (a '96 Mercury Grand Marquis V8) has four coils with two cylinders that fire together in series. Each spark plug then fires once per revolution on the compression and exhaust stroke. Can I use an inductive pickup loosely coupled to the four HV wires coming out of the coil pairs? What can I use as an inductive pickup? I would also like to purchase software and interface cables to use with my PC to read OBD-II trouble codes from my vehicle computer. Do you know where I can purchase this equipment?

Ken Overland
via Internet

A. Oh boy, this is a tough one because you have four coils, so let's look at it one section at a time. You'll still need to derive the horizontal from spark plug #1 as described in the Aug. '99 issue, so that's cool (actually, you can use any plug wire to trigger the sweep). You can also use this signal for the tachometer (the Points In on the block diagram) so that the sweep rate will follow the engine RPM. As for displaying the individual plugs on the vertical input, that's harder because you have four signals. What I'd do is use a scope capable of displaying four traces on one screen. Don't have a four-trace scope? Not a problem. This circuit will give your single-input scope that capability.



This adapter, based on a dual-channel MAX4052 analog multiplexer, displays four analog signals on any oscilloscope via a single vertical input port. It does this by rapidly switching between the inputs as the trace sweeps across the face of the screen. What the adapter does is take a slice of each input and place it on the screen, then quickly switch to the next and do the same, until all four signals have a slice of their signal showing. When the sampler reaches the bottom of the list, it starts all over again, adding yet another piece to the waveform puzzle. And so it continues. The limiting factor to this approach is that the sampling rate has to be fast enough so there are no significant missing slices. This circuit has a 10 kHz sampling rate, which is capable of handling digital signals up to 1 MHz and analog signals at least through the audio range. As for the inductive pickup, I'd use a surface-mount 100 uH coil placed near the coils HV output. A fouled plug will show itself easily using this scheme because the input gain is the same for all inductors. The problem now is sorting through this scramble of information and deducing which plug is the bad apple. Maybe you can narrow it down by swapping pickups. Just remember, I've never built or tested these circuits as a system, only individually and they work, but I can't guarantee they'll work in harmony together. This is just guidance; I'm sure some tweaking will be required.

As for finding hardware and software to interface your PC with OBD-II computer, here are two companies that sell it at very reasonable prices (starting at $122.00).

Alex C. Peper
http://www.obd-2.com/
EASE Diagnostics
1-888-366-3273; http://www.easesim.com/products.htm

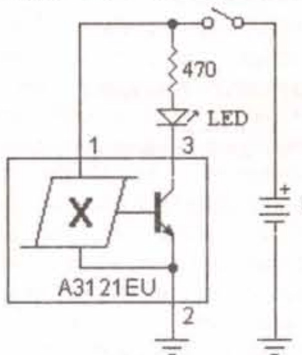
For those readers who don't know about OBD, it stands for On-Board Diagnostics and it is found in most cars and light trucks on the road today. During the '70s and early '80s, car makers started using electronic means to control engine functions to meet the newly imposed EPA emission (smog) standards. Since these "computers" were monitoring the engine's vitals already, it was a short step to interface with computer-based diagnostic equipment. Through the years, the process became more sophisticated, with a lot of variations along the way, until 1996, when the industry agreed on the OBD-II standard. Bottom line, if you want to know the health of your car, including details about the transmission and suspension, these readout gadgets can save you a bunch of bucks on car repair by catching a gremlin before it becomes a headache — or a disaster. If the demand is enough, I'll expand on the OBD-II format in a future column.

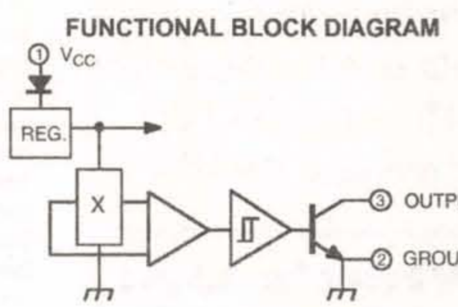
Proximity Solenoid Tester

Q. I'm considering buying a pen-size instrument that detects strong magnetic fields, like that found in an electric solenoid valve. When the solenoid valve is energized, there is a strong magnetic field present that causes an LED in this little tester to light. I'm specifically thinking of one called "Little Devil," which sells for about $30.00. I wonder what the guts are in these testers?

Peter Stratigos
via Internet

A. I'm not sure what's inside the Little Devil, but I suspect it's a Hall-Effect sensor. Hall-Effect devices are unique in that they can detect and measure static magnetic fields; that is, unfluctuating magnetic fields like that from a stationary permanent magnet or electric solenoid. Inductive magnetic sensors, on the other hand, need a changing magnetic field — one where the field periodically increases and decreases in strength, like a spinning permanent magnet. The Hall-Effect circuit is quite simple, requiring just four parts total.





The A3121EU chip (RadioShack RSU 12035846) is actually a switch with a built-in Hall-Effect sensor, op amp, Schmitt trigger, voltage regulator, and an output transistor. When the magnetic field exceeds 350 Gauss, the transistor turns on and conducts current. This, in turn, causes the LED to light. That's all there is to it. Total cost is about $2.00, not including the enclosure.

Magnetic Measures

Q. I'm confused about Gauss and Oersterds. How are magnetic fields measured? I need this information for a transformer I'm trying to wind.

Les Holmes
via Internet

A. The units for measuring magnetic fields are Gauss and Oersted. Magnetic flux density is measured in Gauss, while magnetic field intensity is measured in Oersted. The ratio of B, magnetic flux, in Gauss, to H, magnetic field, in Oersted, is defined as permeability, "µ" (pronounced "mew"). The B/H ratio, or "µ," is a measure of the material's properties. It is high for ferromagnetic materials. In air "µ" is equal to one, making Gauss and Oersted identical numerically, adding to the confusion. Still confused? Me, too.

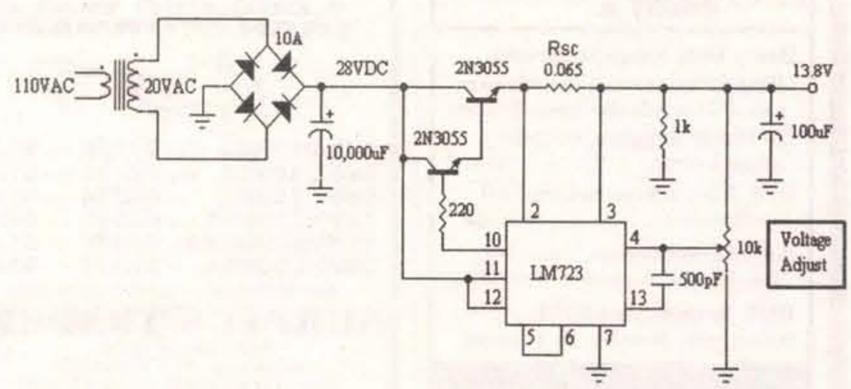
POPS (Plain Old Power Supply)

Q. I have two regulated power supplies which are not working. One is a Pyramid 30 amp and the other is an Astron 20 amp. The Pyramid was stripped by the previous owner and the Astron burned up the control board.

So now I have two good power transformers and rectifiers that put out about 25 to 30 volts unregulated; plus four 2N3055 power transistors on each chassis. All the rest is zapped. If you will, I need a circuit that I can use to put these supplies back in use — just a simple regulator circuit to hold at 13.8 volts would do nicely. Short circuit protection would be nice, but not necessary. Can you help?

Frank Schwartz
via Internet

A - This is an easy order, thanks to the venerable LM723 regulator chip. By itself, the LM723 can only provide 150 mA of output current, but external transistors can be added to provide load currents as high as 10 amps and more. The following circuit is an 8-amp, 13.8-volt power supply using the parts you have on hand.



The power supply is powered by a line transformer with a rectified output of about 28 volts DC (anything between 25VDC and 30VDC will work; but the higher the input voltage, the hotter the 2N3055 transistors will run). The 2N3055 is rated at 115 watts, 15 amps, so I've limited this design to 8 amps. By limited, I mean I've selected the value of the Rsc resistor, that's across the current limit (pin 2) and current sense (pin 3) pins, so that the power supply output voltage drops to zero when the 8-amp limit is exceeded. (If the input voltage is 28 volts, the output voltage is 13.8 volts, and the load current is 8 amps, then the 2N3055 has to dissipate 113.6 watts of heat — which is pushing the power envelope.) The formula is

$$\text{Rsc} = \frac{0.65\text{V}}{\text{I(limit)}}$$

In Search Of The Lost IC

Q - I have a scanner that has a bad IC, which for the life of me, I can't find a replacement. The markings on this chip are NJM3359. Do you have any answers?

Tim
via Internet

A - Well, finding replacement chips can be both tricky and frustrating. I get so many requests like this that I'm going to give our readers the "Yellow Brick Road" solution that I use to find IC replacement parts.

STEP 1: Try to identify the manufacturer. This will tell you if this is an over-the-counter chip or a propriety device. As it turns out, NJM parts are made by JRC, which tells me this is a stock part, which means it's worth my time to search it out. The table below is an overview of manufacturer prefixes, but it is by no means definitive. You can download this table from our website under the name ICPREFIX.PCX or ICPREFIX.DOC (Word 6.0 format).

STEP 2: Go to **QuestLink (http://www.questlink.com)** and enter the part number under Search. When searching, I usually drop the prefixes and all suffixes. For example, instead of searching for an NJM3359AN, I'll enter 3359. Yes, I get a lot of bad hits but, in this case, I discovered that Motorola makes an identical chip under the guise of MC3359. Make a note of this, because it will be helpful very soon.

STEP 3: If STEP 2 fails to produce results, go to the on-line catalogs and try the same type of search, using nothing but the 3359 search seed. Using this approach I discovered a lot of Amp connectors, but scrolling through the Mouser site produced, guess what — an NJM3359D for just $1.20. Here's where I'd normally stop, but let's say I couldn't find an NJM3359 or an MC3359. Then I go to STEP 4. Here's a list of the on-line catalogs that I use, in the order that I address them.

Digi-Key
http://www.digikey.com

Jameco
http://www.jameco.com

Tech America
http://www.techam.com

Newark Electronics
http://www.newark.com

Mouser Electronics
http://www.mouser.com

Allied Electronics
http://www.alliedelec.com/default.asp

Alltronics
http://www.alltronics.com

STEP 4: Look for a replacement part from **NTE (http://www.nteinc.com)**. While there are other replacement parts out there, like RCA's SK series, NTE is the most comprehensive. Incidentally, the NTE part numbers are identical to ECG part numbers, which are stocked by **Tech America (aka RadioShack; 1-800-877-0072, http://www.theshack.com)**. However, my search for an NJM3359 produced nada. Fortunately, my discovery of the MC3359 twin did find an NTE replacement, the NTE 680. I'd now go to RadioShack and order an ECG 860 and have the problem solved. Total cost, $5.60.

STEP 5: If all the above fail, I pull out the big guns and search the obsolete/obscure parts dealers. They are as follows:

Just In Time IC's
http://www.batnet.com/justintime/JUTIC.html

Onlinetechx
http://www.onlinetechx.com

D.R. Components
http://www.drcomponents.com/stockcheck.html

Surfing through these web sites produced three hits, two for the MC3359 and one for the NJM3359. Mission accomplished. What about chips you can't find, you ask? In 90% of the requests, I can find a replacement chip for you, but it's a low priority request and I don't normally publish the results. I'll send you E-Mail. But sometimes, it's a dead end. For example, a reader a while back needed a microprocessor chip for his Osterizer blender. That chip is no longer available, and I couldn't help him (they haven't made it for 20 years). Well, that's how I do it, and now you know how to do it, too. While this task isn't always easy, vendors like **ON Semiconductor (602-244-6600; http://www.onsemi.com)** provide second sourcing for many popular chips that lightens the burden. BTW, I'm open to suggestions for avenues that I can use to expand my search scope.

IC Prefix	Manufacturer	Phone Number	Web Site
ALDxxx	Advanced Linear Devices	408-747-1555	http://www.ald.com
ADxx, OPxx	Analog Devices	800-262-5643	http://www.analog.com
OPAxx, INAxx	Burr-Brown	520-746-1111	http://www.burr-brown.com
ELxxx	Elantec	888-352-6832	http://www.elantec.com
LMxx, RCxx, KAxx, uAxx	Fairchild	207-775-8100	http://www.fairchildsemi.com
MBxxx	Fujistu	408-922-9000	http://www.fujitsumicro.com
CAxx, HAxx, HCxx, HFxx	Intersil	407-724-7000	http://www.intersil.com
LFxx, LMxx, LTxx, OPxx	Linear Technology	408-432-1900	http://www.linear-tech.com
MAXxx, ICLxx	Maxim Integrated Prod.	408-737-7600	http://www.maxim-ic.com
MICxxx	Micrel	408-944-0800	http://www.micrel.com
LMxx, LFxx, LHxx, CLCxx	National Semiconductor	800-272-9959	http://www.national.com
NExx, SAxx	Philips Semiconductor	800-234-7381	http://www.semiconductor.philips.com
BAxxx	Rohm	--	http://www.rohm.co.jp
LMxx, MCxx, TSxx, etc.	STMicroelectronics	781-259-0300	http://www.st.com
TLxx, TLCxx, TLVxx	Texas Instruments (TI)	972-644-5580	http://www.ti.com
TAxxx	Toshiba	212-596-0600	http://www.toshiba.com/taec

PICmicros & BASIC

PicBasic Compiler - $99.95
PicBasic Pro Compiler - $249.95

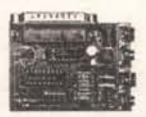
Now it's even easier to program the fast and powerful Microchip PICmicros. The PicBasic and PicBasic Pro Compilers convert your English-like BASIC programs to files that can be put directly into a PICmicro. True compilers for faster, longer programs. BASIC Stamp™ I/II* libraries. For mid-range PIC12C67x, 14Cxxx, 16C55x, 6xx, 7xx, 8x, 87x, 9xx and high-end 17Cxxx (PicBasic Pro only).

*BASIC Stamp is a registered trademark of Parallax Inc.

New! PIC-X1 Experimenter/ Lab Board

Assembled - $199.95
Kit with parts - $139.95
Bare PCB only - $49.95

EPIC Plus PIC Programmer - $59.95



Programs PIC12C5xx, 67x, 14Cxxx, 16C505, 55x, 6xx, 7xx, 8x, 87x and 9xx. Optional ZIF adapters for DIP, SOIC, MQFP, PLCC. Runs off two 9-volt batts or optional AC adapter. Includes programming software and assembler.

PICProto Prototyping Boards

Get it wired quicker! High-quality blank prototyping boards for PICmicros. Holds PICmicro, 5V reg, caps, oscillator, DB9-25, large proto area. $8.95 - $19.95

microEngineering Labs, Inc.
Box 7532 Colorado Springs CO 80933
(719) 520-5323 (719) 520-1867 fax
http://www.melabs.com

Write in 39 on Reader Service Card.

Power Quality Inc. 800-255-5545 Fax: 520-344-8847

Heavy Duty Surge Suppressor
Plug Strips, 6 outlet, circuit breaker, Case of 25 in individual boxes..$50/case
HP Power Supplies, HP6260B current is 0-50A, ...$100
UPS, 250va to 3 kva, functional and nonfunctional ....Please call
Power Conditioners, Oneac, TLC, Teal, Sola, various sizes.......Please call
BMI, Dranetz, and RPM Power Quality Monitors.......... Please call

www.powerqualityinc.com

SURPLUS SALE

1,000,000 WALL TRANSFORMERS

3VDC/100MA .... CX099 .... $0.75
6VDC/100MA .... CS039 .... $1.45
9VDC/100MA .... CR314 .... $1.45
12VDC/200MA .... CS033 .... $0.99
13.5VAC/400MA.. CR574 .... $1.29
24VDC/500MA .... CR174 .... $3.40
Min 1000/type -- Call for other types

SURPLUS TRADERS
PO Box 276,
Alburg, VT 05440
Tel: (01) 514-739-9328
Fax: (01) 514-345-8303
http://www.73.com/w
FREE CATALOG!

IC PROGRAMMERS

ADVANTECH EETOOLS NEEDHAMS DATA IO BP MICRO XELTEK SYSTEM GENERAL ICE TECHNOLOGY CHROMA

1295 Advantech Labtool-48
895 Needham EMP-30
869 EETool Topmax
650 Xeltek SuperPro III
629 ICE Tech Micromaster LV
469 Xeltek SuperPro F
419 Needham EMP-20
419 EETool Megamax
379 Xeltek SuperPro LX
299 EETool ChipMax
279 Xeltek Rommaster II
209 Needham EMP-10
Gang Programmers 4 TO 8 Sockets
CALL Advantech Labtool-848 8XGang
1085 EETool TopMax W/8XGang
689 Needham SA-20 8X Gang
529 EETool MegaMax4G 4XGang

LABTOOL 48
LABTOOL 848
WE CARRY THE BEST SELECTION IN THE WORLD!

General Device Instruments
Sales 916-393-1655 Fax 916-392-4949
Order Only Toll Free 800-760-3820
WWW.GENERALDEVICE.COM
WWW.LABTOOL.COM

COMPUTER

BAREBONES SYSTEM THAT INCLUDES:
44X CD-ROM Drive
1.44MB Floppy Drive
56K V.90 Fax/Modem
64 bit 3D AGP Video, 8MB shared
3D Sound with Wavetable
10/100Mbps Ethernet Network Port
UDMA/66 Hard Drive Controller
Removable Hard Drive Rack
Micro ATX Case with Power Supply
3 SDRAM slots for up to 768MB Ram
1 Serial, 1 Parallel, 2 USB Ports
Keyboard, Mouse, Speakers
Accepts ALL Slot 1/Socket 370 CPUs
Just add CPU, memory, and Hard Drive
$245
Visit our website for more details and CPU, memory and hard drive options
www.lapazelectronics.com
La Paz Electronics International
PO Box 261095 San Diego, CA 92196
Order 1-(800) 586-4199 Fax (858) 586-1482

CUSTOM PLASTIC PARTS

- MODELS (WOOD AND RESIN). TO EVALUATE YOUR PARTS BEFORE COMMITING TO MANUFACTURE A MOLD.
- MOLD DESIGN AND BUILDING.
- PRODUCTION OF INJECTION MOLDED PARTS. NO ORDER TO SMALL OR TO BIG.
- VERY COMPETITIVE ON HIGH LABOR PARTS.

We also have manual low pressure machines for injection molding of very small runs or prototypes of parts up to 2 oz. At a surprisingly low price.
USA. Office: V&V Mach.&Equip Inc.
Tel (281) 397-8101, Fax (281) 397-6220.
Please send blue prints or samples to:
Marketing Tech. S.A. •Alamo 93, 4.Piso • Sta. Monica, Tlal. • Edo. de Mexico 54040 • Tel. 011 (525) 361-3351. Fax 011(525) 361-5996. ATTN: VICTOR M.MENDOZA e-mail. marktech@infosel.net.mx
PLEASE VISIT OUR SITE
WWW.VANDVMANCHY.COM

SECURETEK
DIRECT FROM MANUFACTURER
"WE WILL BEAT ANY COMPETITORS PRICE"
WORLD SMALLEST WIRELESS VIDEO CAMERA
(BLACK & WHITE OR COLOR)
TRANSMITS VIDEO UP TO 1000FT.
WE ALSO CARRY:
- COVERT VIDEO CAMERAS
- COUNTER-SURVEILLANCE PRODUCTS
- CUSTOM MADE VIDEO SYSTEMS
- IN HOUSE ENGINEERING DEPT.
RUNS ON 9V BATTERY FOR UP TO 12 HRS.
DISTRIBUTOR PROGRAM AVAILABLE
CALL FOR CATALOG:
SECURETEK
7175 S.W. 47TH STREET MIAMI, FLORIDA 33155
TEL.305.667.4545
FAX.305.667.1744
www.securetek.net

Price Reduction
- GPS Trimble SV6 w/ Mag Ant $49.95
- Rockwell MicroTracker I I $49.95

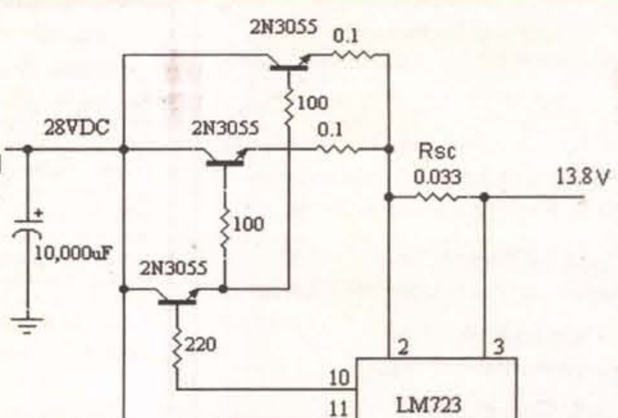
Just in - Siemens Gigaset 2420 2 unit Cordless System.......... $199.00

Communications Surplus
713-526-8000 or
1-877-878-6GPS(477)
commsurplus@ev1.net
Fax to 713-522-6309

HIDDEN SECURITY CAMERAS

Worlds Smallest Wireless Camera
434 MHz $249 900 MHz $249
Beeper Camera
PnP $225 434 MHz $379
Wireless Wall Clock Camera
PnP $195 434 MHz $349
Wireless Eyeglass Case Camera
PnP $195 434MHz $325
Wireless Clock Radio Camera
PnP $225 434 MHz $379
OTHER ITEMS AVAILABLE CALL FOR A FREE CATALOG
J. J. Hill, 188 Virginville Road, Hamburg Pa 19526
Phone: (610) 562-1532 Fax: (610-562-0658)

Electronics Q & A



If you want to lower the output current limit, increase the value of Rsc. For example, a 1-amp load limit calculates out to be 0.65 ohms. To increase the output current, you have to parallel the top pass transistor. Just make sure you include a small 0.1-ohm resistor in series with the emitter leads and a separate base resistor (100 ohms) for each 2N3055 when paralleling them; the collectors can be tied directly together. Here's what that section of the circuit looks like.

TV 85 PJ & TV 86 CABLE CONVERTERS VOLUME & NON-VOLUME CONTROL
SALES/SERVICE
VOICE 1-800-473-0506
FAX 1-800-488-0525
FOSS WAREHOUSE DISTRIBUTORS
285 Schenck St.
N. Tonawanda, NY 14120
www.fossw.com

UHF Wireless Telephone Recorder
Easy to install Superb sound quality
ONLY $299.00
The UX-200 is a UHF telephone transmitter with combined Receiver & Recorder, which works with battery or mains. It will record up to 7 Hours and has a range of more than 100 meters.
Bitz Technology
E-mail:
Bitztechnology@compuserve.com

Mailbag

Dear TJ:

In the Sept. '99 issue, Garry Iman asked about using a 115VAC, 400 Hz Variac. You mentioned using two of them in series powered by the 60-Hz line. I find this questionable since it means the output has no neutral reference and some people may forget that these are autotransformers and there is no line isolation here.

I think there is a better use for this unit. I suggest placing the Variac across a 24VAC transformer (RadioShack 273-1512 or better), and voila! — an adjustable 0-24VAC source at up to 2 amps. The transformer provides isolation, the 24-volt secondary prevents saturation of the core (the source of the excessive current draw and overheating), and the Variac provides adjustability. I did something like this with a 12-volt transformer and a 48-volt 400-Hz Variac a while ago, and was surprised how handy this device can be. Just my $.02 worth.

Francis Grosz WD5IBJ
via Internet

Your suggestion is worth more than two cents! Thanks for sharing your discovery.

TJ Byers
Q & A Editor

Dear TJ:

The Dec. '99 Q & A suggested substituting a uA741 for a uA702, but I'm not so sure that it would work. The uA702 is a wideband amplifier, and Wavetek may have chosen it for that feature. The gain is low (about 2,000), but the uA702 can be configured for a gain of 100 with a 5MHz cutoff — that's a gain-bandwidth product of 500MHz. The uA741 has a gain-bandwidth product of about 1MHz, so, the substitution may fail. It depends on the circuit and the upper frequency range of the function generator (which was not given).

Jerry
via Internet

I contacted Bob Pease, who writes a column for EDN and was the co-inventor of the uA702, and he agreed that an LM741 would work in this application.

TJ Byers
Q & A Editor

PCB EXPRESS, INC.

PROTOTYPE TO PRODUCTION

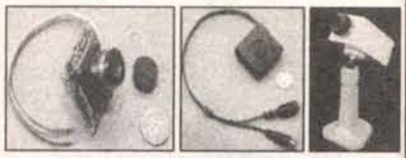
S/SIDED: 5-days, 10 Pcs.	$275.00
D/SIDED: 5-days, 5 Pcs.	$300.00
D/SIDED: 5-days, 10 Pcs.	$350.00
4-LAYERS: 5-days, 5 Pcs.	$750.00
4-LAYERS: 7-days, 10 Pcs.	$850.00
6-LAYERS: 5-days, 5 Pcs.	$950.00
6-LAYERS: 7-days, 10 Pcs.	$1,175.00

(Up to 30 sq. inch each, includes Tooling)

SERVICES *– UL Approved*
SMOBC, LP1 mask & Legend
Photoplotting, Electrical Testing
Thru hole/SMT, Gold/Nickel Plating
Routing and Scored Panel, Instant Quotes

PH: **(888) 427-2920**, Fax **(847) 427-1949**
E-Mail: cir1920@aol.com
LOWEST COST & FAST DELIVERY

VIDEO PRODUCTS



CNL-100	BX-120-P	SX-800
$49	$59	$79

- 430 TV Lines Resolution
- 9-14 VDC Operation
- Infrared Sensitive
- SX-800 has Audio Output
- A-300 Camera Enclosure also available

MATCO, INC.
Schaumburg, IL
1-800-719-9605 • 1-847-619-0852 FAX
E-Mail – info@mat-co.com
Website – www.mat-co.com

10&14 Hour Telephone Recorders

Starting at **$69** +$6.95 S/H
Times based on a 180 tape 14 Hour $89+S/H

120 Tape included!

Automatically starts recording when the phone is picked up and stops when you hang up. Records both sides of the conversation! Printed catalog $3 (free with order)

Visit our Online Catalog
www.mscelectronics.com

MSC Electronics
PO BOX 461 Jessup, MD 20794
(301) 497-1600
FAX (301) 497-1925
No Checks • US & Canada Only
VISA MasterCard

EPS

EPROMS AS LOW AS 25¢

27C256	27C040	27C1024	87C51
27C512	27C400	28F010	8751
2732A	27C4096	28F020	8755
27C32	574000	28F040	MC68HC70 5C8A
27C128	574200	8749H	PIC16C56
27C64	27C402	8748H	PIC16C54
2716	27C020	8741	PIC16C622
2708	27C210	8742	GAL16V8
27C512-90	27C010	8744	GAL22V10

STATIC RAM: HM628128, 62256, 6264, 6116
PROCESSOR: 8255, 8254, 80C31
MEMORY, **D-RAMS**, **SIMM**

- Many more parts in stock
- All major brands
- All guaranteed

E-Mail: eproms@aol.com
TEL: (818) 774-9444 · FAX: (818) 774-0822
WE BUY EXCESS INVENTORY

FREE SAMPLE COPY!

ANTIQUE RADIO CLASSIFIED

Antique Radio's Leading Monthly Magazine

Articles – Classifieds – Ads for Parts & Services. Also: Ham Equip. – Books – Telegraph – 40's, 50's & 60's Radios – Early TV – Auction Reports & more...

1-Year: $39.49 ($57.95 by 1st Class)
6-Month Trial - $19.95. Foreign - Write.
A.R.C., P.O. Box 802-G23
Carlisle, MA 01741
Call: 978-371-0512 — Fax: 978-371-7129
Web: www.antiqueradio.com

MFM COMMUNICATIONS

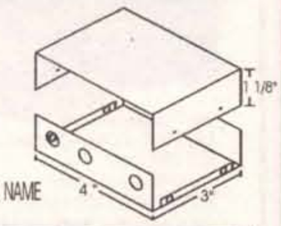
NOW IN STOCK —
- Magnetic Strip Reader/Writers
- Mobile Mag-Strip Readers
- 7816 Programmers

PLUS
A wide range of cellular accessories

24 HOUR DELIVERY
Tel/Fax: 011441342312403
http://members.aol.com/mfmcom123/index.htm

CABLE BOXES

CUT MANUFACTURING COST!
WE ACCEPT SMALL ORDERS TOO.

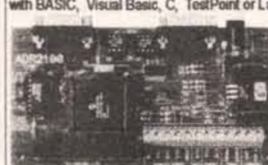


ALSO PCB, SMT, PROTOTYPES, ASSEMBLY, PLASTIC MOLDS, INJECTION MOLDING

USA Office: **V&V Mach. & Equipment, Inc.**
Ph: (281) 397-8101, Fax: (281) 397-6220.
Mexico Plant: **Marketing Tech.**
Ph: 011 (525) 361-3351, Fax: 011 (525) 361-5996.
PLEASE VISIT OUR SITE
WWW.VANDVMACHY.COM

Data Acquisition and Control via RS232 or RS485 Ports

The ADR interfaces connect to any serial port and allow data acquisition and control using simple ASCII strings. Easy to use with BASIC, Visual Basic, C, TestPoint or LabVIEW.



Many versions available with A/D, D/A, DIO and relay I/O. Visit our web site for details.

ADR2100.......$199 ; 32 digital I/O (20mA) ; 4,10-bit analog inputs ; 2, PWM ports, 2 event counters ; 4 interrupts, 1 auxiliary output ; Dual stepper motor indexer ; RS232 to RS485 converter ;Daisy-chain up to 10 units ; Regulated 5VDC out@100mA

ONTRAK CONTROL SYSTEMS
Ontrak Control Systems Inc.
(705) 671-2652
(705) 671-6127 FAX

More products and applications at;
www.ontrak.net

ASSEMBLY & ENGINEERING

Producible designs since 1970

Contract Engineering
- Embedded Microprocessors
- PCB Layout and Packaging Design
- Analog Including RF to 1 GHz
- Instrumentation
- A/D and D/A

Contract Assembly
- High-Speed Fuji Surface Mount
- Through hole
- Turn-key or Kit
- Run sizes one through thousands
- Test and burn-in available

Bilocon Corp.
800-736-5927
425-353-2276
www.bilocon.com

Stereo Microscopes for Large PC boards

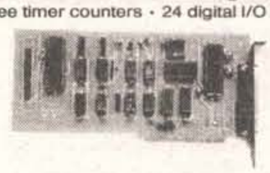
9 in. arm for Large boards
-10X & 30X
-Dust cover
-Eye guards
-5 year warranty
ST 231P – $395.00

jlittle@netwizards.
Technical
3580 Haven Ave. Redwood City, CA 94063
650/367-8320 Fax 365-5845

CONTROL · MEASURE · INPUT

MODEL 40–$109
- RS-232 interface
- 28 lines digital I/O
- Eight analog inputs
- PWM output
- Three stepper ports

MODEL 100–$279
- 12-bit 100KHz A/D · Four analog outputs
- Three timer counters · 24 digital I/O



PRAIRIE DIGITAL, INC.
920 SEVENTEENTH ST., INDUSTRIAL PARK
PRAIRIE DU SAC, WI 53578
TEL: (608) 643-8599 · FAX: (608) 643-6754

dmdsystems.com

[electronic test & mfg]
[test]
[measurement]
[rf/microwave]
[specialized equipment]
[computers]

DMD SYSTEMS RECOVERY, INC.
602 305-8485
fax 602 305 8490 • email info@dmdsystems.com

ASTRO TOO

Surplus/Electronics Equipment

Web Site: AstroToo.Com
E-Mail: Astro@AstroToo.Com

2854 Sarno Road
Melbourne, FL 32935

(407) 253-3371
Fax: (407) 727-1546

When visiting Central Florida, come see us! I-95, Exit 72

GRADE "A" CD RECORDABLE DISKS

DIAMONDBACK CD-R

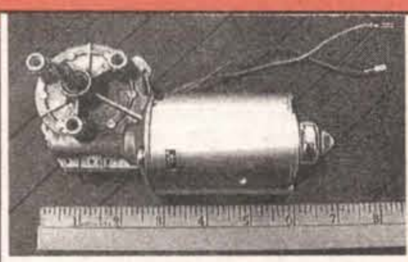
DISK TYPE	QTY	EA	SPINDLE
74 Min. 650MB			$79.00
(on spindle)	100	.79	Silver/Silver
80 Min. 700MB			$129.00
(on spindle)	100	$1.29	Silver/Blue

- Excellent for Music and Data Integrity
- Reliable OEM Quality

Call Toll Free 1-(888) 967-8400

RISK FREE DISKS, INC.
— OUR 20TH YEAR —
www.riskfreedisks.com

VISA MasterCard DISCOVER NOVUS



GEARHEAD MOTORS, 24VDC
BRAND NEW OEM SURPLUS
HIGH TORQUE
.45A NO LOAD @ 24 VOLTS
35 REVOLUTIONS /MINUTE @ 24V
19 REVOLUTIONS /MINUTE @ 12V
3/8" DIA., 1" LONG SLOTTED SHAFT W/ 1/8" HOLE
WEIGHT: 2.5 LBS
PRICE: $10.00 EACH + SHIPPING
(CALL OR E-MAIL W/ YOUR ZIP FOR CHARGES)

DIVERSE ELECTRONIC SERVICES
1202 GEMINI ST
NANTICOKE, PA 18634-3306
570-735-5053   603-415-7649 [FAX]
http://members.tripod.com/~divelec
carik3jml@bigfoot.com

Doctor GB card // Xchanger for Professional Game Developers

Doctor GB card is a Gameboy compatible ROM emulator FlashROM cartridge. It has built-in SRAM and supports MBC1 MBC2 and MBC5 standard.

The advanced design of the Doctor GB card and Doctor GB Xchanger makes it easy for programmers and coders to burn a ROM file to the Doctor GB card. To transfer data into the Doctor GB card, the only requirements are the Doctor GB Xchanger, PC and our customized software. No need for expensive and difficult to use EEPROM burner.

www.UpstateGames.com
E-mail : sales@upstategames.com Fax : (716) 442-7223
P.O. Box 40184 Rochester, NY 14604 U.S.A.

GPS Design Kit — $379

The design kit SGM5600KS is a complete and immediately usable means of evaluating the SiGEM GPS receiver module and high performance GPS antenna, which are included in the kit. Software running on the GPS receiver module communicates to a user supplied computer via NMEA 0183 formatted messages. Advanced PC software provides map integration and a demonstration of tracking. Provision has been made for DGPS inputs.

SiGEM Inc.
50 Hines Road
Kanata, Ontario
Canada K2K 2M5
Tel: (613) 271-1601 (Can)
(541) 923-3733 (USA)
Fax: (613) 271-1896

SiGEM

Web: www.sigem.ca
Email: info@sigem.ca

SINGLE SIDED PCBs — 9¢

9 ¢ PER SQIN, $100 SET UP,
SMOBC, ONE OUNCE COPPER,PC75, 1/16",
ONE SOLDER MASK AND ONE SILK SCREEN.
NEGATIVES $ 50

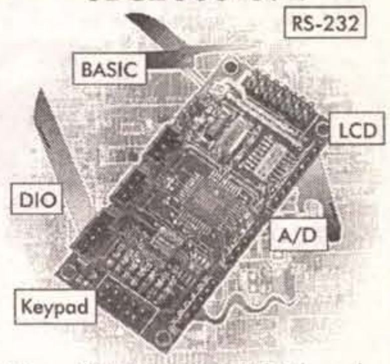
DOUBLE SIDED PCBs — 14¢

14 ¢ PER SQIN, $150 SET UP,
PTH, ONE OUNCE COPPER,
FR4, 1/16", TWO SOLDER MASKS AND ONE
SILK SCREEN. NEGATIVES $ 75.

* THESE PRICES APPLY ONLY TO RECTANGULAR PCB'S

PLEASE VISIT OUR WEB SITE FOR MORE INFORMATION AND OTHER PRICE EXCEPTIONS
WWW.VANDVMACHY.COM
V&V MACHY & EQUIP. INC (HOUSTON TX. OFFICE)
PH. (281) 397 6220
MARKETING TECH. S.A. (MEXICO PLANT)
PH. 011 525 361 3351, FAX. 011 525 361 5996

SBC2000-074



Versatility starting at $64 each.

Voice: 303.422.8088 Fax: 303.422.9800
www.sbc2000.com
Vesta Technology, Inc.

2.4 GHz Wireless Transmitter & Receiver

$89/pair @ 50 pcs

2.4 GHz ~ 2.48 GHz User Selectable
Over 700' Range and 4 Chl Auto-scan
NTSC, PAL, Composite video B/W or Color
2 Audio Inputs may be used for digital data
Customizations including battery packs
and Special Frequencies

Matco Inc.
(800)440-0299 or (800)719-9605
www.mat-co.com

Telecom Hardware/Software Developers

STOP using your phone lines to test and demonstrate your telecom devices. Our affordable telephone line simulators offer authentic USA dial tone, busy signals, ringing, and exceptional speech quality.

RING-IT! TELCO SIMULATOR
- Single Line (two RJ-11 Jacks)
- LED Display
- DTMF Operation
- Automatic Ring-up Mode
- **$325** ($149 kit available)

PARTY-LINE TELCO SIMULATOR
- Six Extensions
- Caller-ID (Name/Nbr)
- Distinctive Ringing
- **$425** ($199.95 kit avail)

Digital Products COMPANY
134 Windstar Circle
Folsom, CA 95630 USA
Tel: 916-985-7219
Fax: 916-985-8460

http://www.digitalproductsco.com

LCD Terminal $99

Re-Programmable
LCD 240 x 64 EL Backlit
RS-232 Port
1200 Baud Modem
8051 Compatible Microcontroller
192k Low Power Static Memory
Infared Transmitter
Nicad Battery Pack
QWERTY Keyboard
FM SCA Data Receiver

Junkware.com
http://www.junkware.com

PC BOARD SERVICES

PCB Design Layout
- Thru Hole
- SMT
- Multilayer

PCB FABRICATION
- In-house Prototypes
- Single and Double Side
- Plate Thru Hole

ASSEMBLY
- Thru Hole
- Small Project Specialists

Serving Engineers and Hobbyists for 16 Years

MIDLAND TECHNOLOGIES
800-726-8871 Voice
406-586-0300 FAX

Press-n-Peel Transfer Film

PC Boards in Minutes

8.5" x 11" Shts.
* Or Photocopy
**Use standard household iron

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch

Press-n-Peel

Use Standard Copper Clad Board
20 Shts $30/ 40 Shts $50/ 100 Shts $100
Visa/MC/PO/Ck/MO $4 S&H/Foreign Add $7

Techniks Inc.
P.O. Box 463, Ringoes NJ 08551
ph. 908.788.8249 fax 908.788.8837
www.techniks.com
Vist Our E-Store On-Line!

ATOMIC TIME

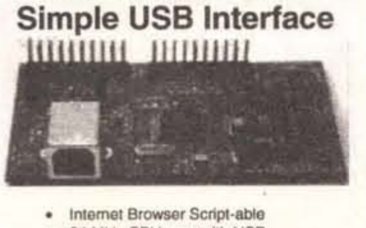
Automatic time synchronization for applications where accurate time is essential to data integrity

FEATURES
- WWVB based
- Serial and LCD outputs
- Y2K compatible
- 0.1 second accuracy

APPLICATIONS
- Network time servers
- Embedded systems
- Timers/sequencers

ULTRALINK
775 782 9758 www.ulio.com

New! ActiveWire™USB Simple USB Interface



- Internet Browser Script-able
- 24 MHz CPU core with USB
- Firmware downloadable via USB
- 16 bit parallel I/O
- Expandable add-on boards
- New firmware and scripts available from website

$59 plus shipping
ActiveWire, Inc.
www.activewireinc.com
ph(650) 493-8700 fx(650) 493-2200

QUALITY KITS

#1 Source for Electronic Kits

Great selection of Hi-Fi AUDIO Kits, PSUs, Transmitters, Oscilloscopes, PIC Programmers, and much more.

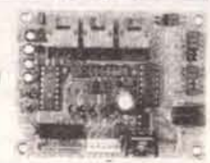
Toll Free Order Line:
1-888-464-5487

Secure On-Line Ordering
www.qkits.com

Call 613-544-6333 for free catalog
North American Kit Distributor
49 McMichael St., Kingston, ON
K7M 1M8, CANADA

Convert RS-232 to RS-485 or TTL/CMOS for Only $49.00

Communicate up to 4,000 feet, at up to 1 MEGA--BPS, full or half duplex, up to 32 units on one serial link, with 31 jumper options for flexible configuration. LED indicators.



COMMUNICATIONS CONVERTER
- FULL SCHEMATIC AND DOCUMENTATION
- FULL FAMILY OF MODULAR DESIGNS
- RS-485/RS-422 REMOTE I/O MODULE KITS
- NETWORK SOFTWARE AND SOURCE CODE
- AUTOMATIC OR RTS UNITS AVAILABLE
- RJ-11/12 CONNECTORS OR TERMINAL STRIP
- TURN YOUR PC INTO A DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEM

R.E. SMITH
(513) 874-4796
4311 TYLERSVILLE RD. ■ HAMILTON, OHIO 45011
www.rs485.com

New TICkit 63

FBasic Micro-Interpreter Module
- ✓ 128 bytes RAM – Up to 256K EEprom
- ✓ Audio playback from EEprom WAV data
- ✓ DTMF and dual tone generation functions
- ✓ X-10 transmit and receive for home automation
- ✓ 32 bit floating point and signed integer math
- ✓ **Background** real time clock & RS232 serial
- ✓ 4MHz version for low power applications
- ✓ Control two motors using **background** PWM
- ✓ Control 4 or 8 servos in **background** at once
- ✓ Coming Soon – Windows Programming tools

Phone: 303-828-9156
Fax: 303-828-9316
Protean LOGIC Inc.

➢ www.protean-logic.com ➢

PRINT to VIDEO!

Tiny BOB-II module superimposes up to 308 characters on NTSC/PAL video or generates video automatically. Fast 2.4~19.2kbps RS-232 serial interface. Simple to control; like a printer. Many powerful applications:

Home Automation - MATV
Video Inspection & Testing
Surveillance - CCTV - ATV
Remotely Piloted Vehicles
Gaming - Racing - Sports
Process/Experiment Monitor
Robotics - Electronic Signs

BOB-II-NTSC only $79.95

Information & Ordering: www.decadenet.com
DECADE ENGINEERING
5504 ValView Dr. SE, Turner, OR 97392
Tel: 503.743.3194 ~ Fax: 503.743.2095

Globaltech Distributors

THE ULTIMATE ELECTRONIC SAVING STORE
Wholesale Prices Available---Don't Miss-Out
Call Today!---1-(800)582-5116

Computer Acc.	Recordable CD's
Remote Controls	Alkaline Batteries
Semiconductors	4 Wire Harness
IC's & Microprocessor	Anti-Virus Prog.
Radios & Amplifiers	Soldering Stations
Satellite Acc.	Cellular Chargers
Telephone Acc.	Hearing Aids
Anti-Tapping Devices	Laser Pointers
2-Way Radios	Power Supplies

Free Internet Service - Free Color Catalog

Buy Direct Buy Today & Save
Order@globaltechdistributors.com

COMPUTER I/O

Model CRD155B

- ISA bus interface
- 24 digital I/O lines (inputs or outputs)
- DB25 connector
- User Manual
- Software API

Price: $45

Please visit our web site for more information and our complete product line.

Winford Engineering
4169 Four Mile, Bay City, MI 48706
Toll free: 1-877-634-2673
www.winfordeng.com

The Controlled World: RS-232 Network Control Methods and Applications

Byte Bugs

by Ryan Sheldon, National Control Devices • (417) 646-5644 • www.controlanything.com

Simple is the name of the game with these exclusive, pre-programmed processors.

Simple is the name of the game, whether you are a beginner or an expert in the field of computer control. Sometimes you just don't have the time to learn a bunch of junk, you just want to get the job done as quickly and as cheaply as possible.

If I just described you, then our new line of Byte Bugs may be perfect for your next simple, low-cost computer-controlled application.

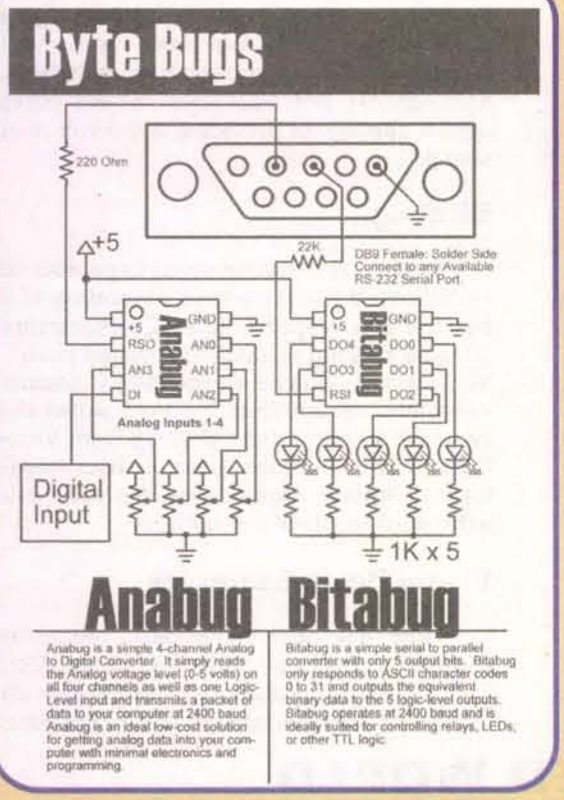
Byte Bugs are simple processors that are pre-programmed with simple instructions to do simple things. Designed by simple minds for the simple-minded, they are easy to wire up using only a few components. Put simply, they don't boast a lot of features or options, they just get the job done cheaply and easily with

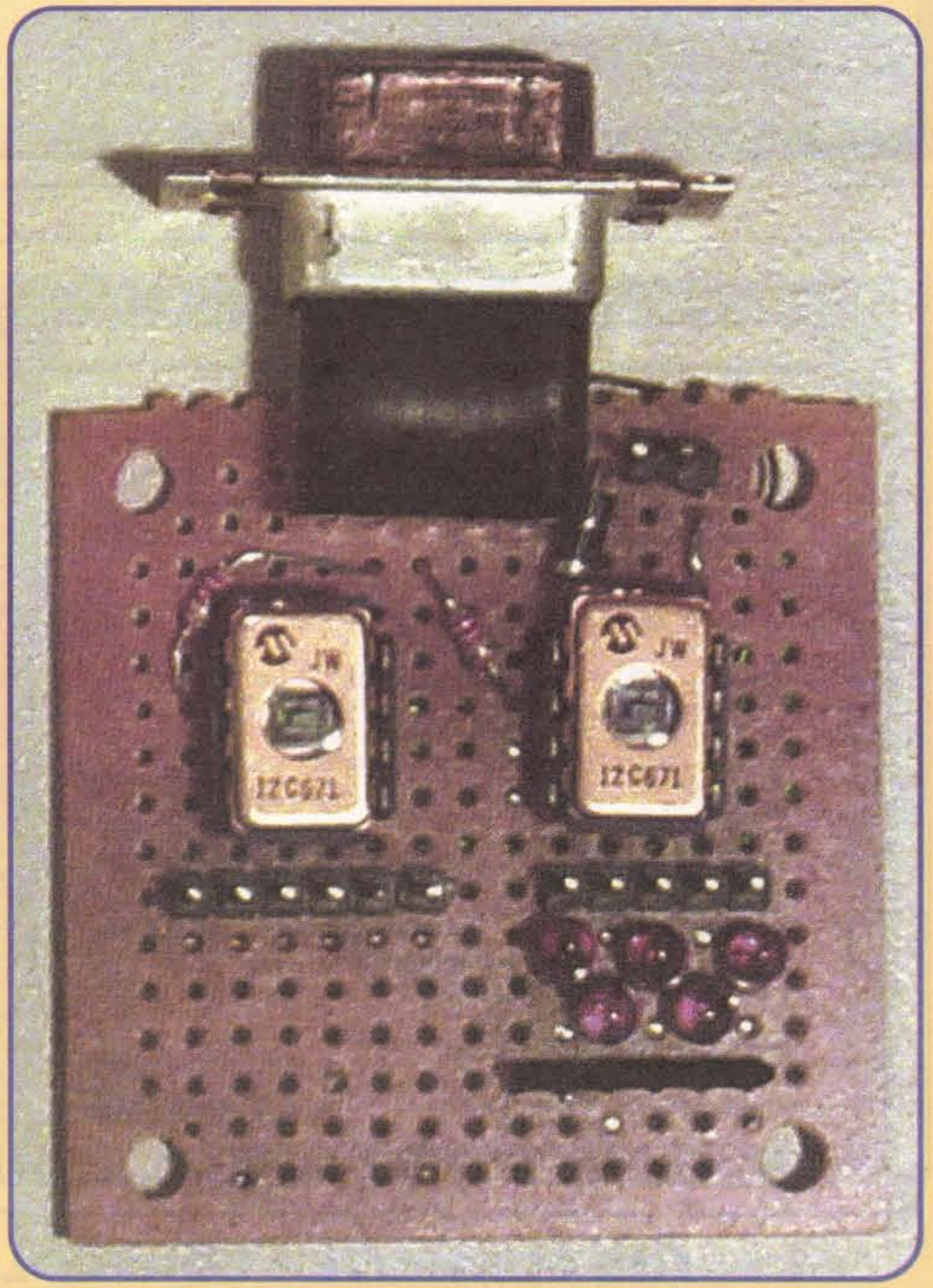
Figure 1 (right) shows Anabug (left processor) with four analog inputs and a digital input; Bitabug (right processor) has five logic-level outputs.

Figure 2 (below) shows the schematic for the Anabug and the Bitabug attached to the serial port of your computer.

Table 1

Byte	Description	Value	Details
1	Header Byte	254	Begins the data packet and is always 254.
2	Analog Input 1	0-255	Analog voltage on input 1 from 0 to 5 volts DC.
3	Analog Input 2	0-255	Analog voltage on input 2 from 0 to 5 volts DC.
4	Analog Input 3	0-255	Analog voltage on input 3 from 0 to 5 volts DC.
5	Analog Input 4	0-255	Analog voltage on input 4 from 0 to 5 volts DC.
6	Digital Input	0 or 1	Logic Level Input 0 or +5 volts DC.
7	Terminator Byte	85	Concludes the data packet and is always 85.





Project1 - Form1 (Code)

(General) | (Declarations)

```
Dim dat(10)
Private Sub Form_Load()

    MSComm1.Settings = "2400,n,8,1" 'Set Baud Rate
    MSComm1.CommPort = 1            'Set the Comm Port
    MSComm1.PortOpen = True         'Open the Comm Port
    Form1.Visible = True            'Show the Interface

    'Continuous Loop to Monitor All 5 Inputs
    Do
START:
        'Get 7 Bytes in the Packet
        For N = 1 To 7
            'Wait for a Byte
            Do
                DoEvents
            Loop Until MSComm1.InBufferCount > 0
            'Grab the Byte and Store in Array
            dat(N) = Asc(MSComm1.Input)
            'Sync the First Byte with the First Byte in the Packet
            If dat(1) <> 254 Then GoTo START
        Next N
        'Make Sure the Packet has been properly terminated
        If dat(7) = 85 Then
            'Set Level Meters
            ProgressBar1(0).Value = dat(2) 'Analog Input 1
            ProgressBar1(1).Value = dat(3) 'Analog Input 2
            ProgressBar1(2).Value = dat(4) 'Analog Input 3
            ProgressBar1(3).Value = dat(5) 'Analog Input 4
            ProgressBar1(4).Value = dat(6) 'Digital Input
        End If
    Loop

End Sub
```

Figure 3 shows the program code for receiving data from the Anabug.

Project1 - Form1 (Code)

Form | Load

```
Private Sub Form_Load()

    MSComm1.Settings = "2400,n,8,1" 'Set Baud Rate
    MSComm1.CommPort = 1            'Set the Comm Port
    MSComm1.PortOpen = True         'Open the Comm Port
    Form1.Visible = True            'Show the Interface

End Sub
Private Sub Command1_Click(Index As Integer)

    If Command1(Index).Caption = "OFF" Then
        Command1(Index).Caption = "ON"
    Else
        Command1(Index).Caption = "OFF"
    End If

    dat = 0
    If Command1(0).Caption = "ON" Then dat = dat + 1
    If Command1(1).Caption = "ON" Then dat = dat + 2
    If Command1(2).Caption = "ON" Then dat = dat + 4
    If Command1(3).Caption = "ON" Then dat = dat + 8
    If Command1(4).Caption = "ON" Then dat = dat + 16

    MSComm1.Output = Chr$(dat)

End Sub
```

FIGURE 5

no frills. So, if you are new to computer control of the outside world, Byte Bugs are an excellent place to start. This month, I am going to introduce two new Byte Bugs: Anabug and Bitabug.

Anabug

Anabug has four analog inputs, a digital input, and an RS-232 output. Anabug simply reads all A/D channels and the digital input, and sends a packet of data out the RS-232 port at 2400 baud. Your desktop computer easily decodes data packets, providing analog information from the outside world to your favorite programming language. Anabug data packets consist of seven bytes and are simple to decode (see Table 1).

Anabug constantly sends packets of data to your computer at 2400 baud. I recently connected a couple of audio lines to the analog inputs of the Anabug. Using the Anabug Monitor program (written in Visual Basic), I was able to get four channels of VU level meter effects that responded VERY fast to incoming signals.

Anabug packets are easily decoded in Visual Basic. Figure 3 illustrates a simple Visual Basic program that decodes data packets generated by the Anabug processor. In this example, the program starts by configuring the communication settings of your serial port. Once configured, the port is opened and the Monitor form is displayed.

The program then synchronizes itself to the incoming data packets generated by the Anabug. This is done by reading incoming data bytes into an array and looking for the 254 header byte. The header byte is stored as the first byte in the array. All subsequent data bytes are stored into the array until the terminator byte (85) is received. The terminator provides an extra level of protection in the event an analog value is read as 254.

Simply put, the program looks for the header byte (254) and the terminator byte (85) filled in the byte 1 and 7 slots, respectively. If these conditions are met, then the progress bars are updated with the current analog and digital values as shown in Figure 4.

Anabug runs at five-volts DC and does NOT require an external crystal or resonator. It only needs a power supply, a connector for the serial port of your computer, and a resistor to be fully functional. Anabug has four eight-bit A/D channels and a logic level input. Anabug is easily interfaced to temperature sensors, light sensors, potentiometers, or any other device capable of providing a 0-5 volt analog signal.

Bitabug

Bitabug is a simple serial-to-parallel converter with a five-bit output. Operating at 2400 baud, it only responds to ASCII characters 0 to 31. The Bitabug is easily controlled from Visual Basic, Qbasic, or the BASIC Stamp with minimal programming. Figure 5 shows how easy it is to control the Bitabug from Visual Basic. Figure 6 shows a simple user interface for the Bitabug. Simply click the buttons to activate/deactivate the outputs.

Visual Basic Examples

Note that these Visual Basic programming examples make use of the MS Comm Control for serial communications. The MS Comm Control is only available in the Professional

Figure 4 (left) shows the level meter interface for the Anabug.

FIGURE 6

NEW CONTACT INFO:
Ryan Sheldon
National Control Devices
P.O. Box 455
Osceola, MO 64776
Phone: (417) 646-5644
FAX: (417) 646-8302
ncdryan@aol.com
www.controlanything.com

SOURCES:

BASIC Stamp II SX, Board of Education
Parallax, Inc.
3805 Atherton Road, #102
Rocklin, CA 95765
Phone: (888) 512-1024
FAX: (916) 624-8003
www.parallaxinc.com
info@parallaxinc.com

ASEL Video Switcher, R85 Relay Controller, VF Display/Controller

National Control Devices
P.O. Box 455
Osceola, MO 64776
Phone: (417) 646-5644
FAX: (417) 646-8302
www.controleverything.com
ncdryan@aol.com

and Enterprise editions. These programming examples are available from my web site at www.controleverything.com.

Availability

Other new Byte Bugs are planned for release in the year 2000. Currently, Anabug and Bitabug are the only ones available for purchase. Note that Byte Bugs are available ONLY to *Nuts & Volts* subscribers for the year 2000. They are priced at $8.00 each in single quantities or buy 10 for $59.00 (it is okay to mix and match). But you MUST have a *Nuts & Volts* subscriber number to purchase. **NV**

Special Pricing for *Nuts & Volts* Subscribers

I would also like to encourage first-time readers to subscribe to *Nuts & Volts* magazine. Last month, we introduced our 10-piece pricing for *Nuts & Volts* readers. Your response was so overwhelming that we decided to offer this pricing plan permanently. We are offering special prices to *Nuts & Volts* subscribers, which can easily save you the cost of the subscription in just a couple of months. We are also offering a FREE upgrade to UPS two-day delivery (domestic shipment only) with a valid subscriber number.

Here's how it works: Subscribe to *Nuts & Volts* magazine. On your *Nuts & Volts* mailing label, you will find a subscriber number. Call us with your order and current subscriber number and receive ANY NCD device at the 10-piece price. *LIMIT ONE DEVICE PER SUBSCRIBER PER MONTH.* Don't let your subscription lapse, because the savings are ONLY valid as long as you are a *Nuts & Volts* subscriber.

THE COMPUTER CONTROLLED WORLD

Be a winner in the new millennium!

As a paid subscriber to *Nuts & Volts*, you will be automatically entered *each month* in our prize drawing!

Join BOB MALMQUIST of Lincoln, NE and GERALD FORNIER of Delmar, MD

CORPORATE SYSTEMS CENTER (pgs. 2 & 95)

will be hosting the JANUARY Drawing!

NETCOM (page 15) will continue to provide prizes monthly!

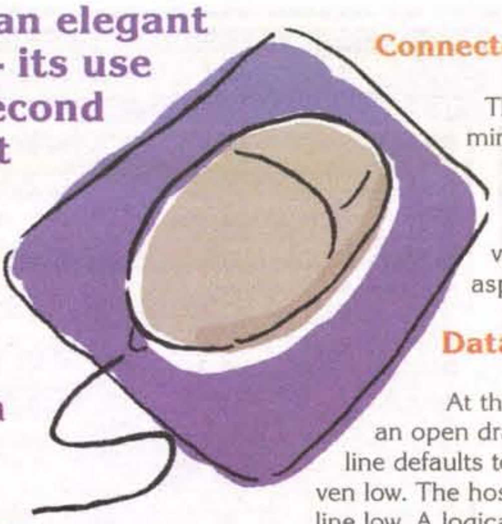
Win great prizes like last month's BASIC Stamp Super Starter Pack from PARALLAX!! *A $500 value!!*

To Subscribe – Just fill in and mail the card supplied in the magazine or call our toll free order line at **(800) 783-4624** with a Visa or MasterCard.

If you do not wish to order a subscription, but would like to be entered in our drawing, simply send or E-Mail your name, address, and telephone number to *Nuts & Volts*, 430 Princeland Ct., Corona, CA 92879 or drawing@nutsvolts.com. No phone entries accepted. All orders/entries must be received by the last day of the month to be included in that particular month's drawing.

BUILDING A BETTER MOUSE TRAP — PART 1

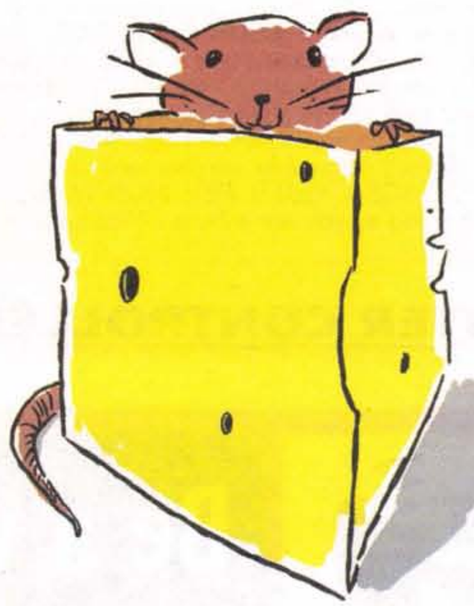
by Steve Parkis



The mouse is an elegant input device — its use has become second nature to most computer users.

Although usually found plugged into a computer, a mouse could serve as a nifty input device for programming your VCR, controlling your model train layout, or other homebrew gadget of choice.

This article describes the PS/2 mouse interface and how to build one with just a single chip — the Scenix SX28 microprocessor.



Introduction

This discussion's scope is limited to a standard, two-button PS/2 mouse from the logical perspective of the plug at the end of the mouse cable. The remarkable optical, electrical, and mechanical functions within the mouse itself are not addressed. The included assembler program is a series of low-level routines to send commands to and receive data from the mouse. These routines may be viewed as building blocks from which a custom, useful mouse-controlled project may be developed. The program also includes an LCD interface used to analyze mouse activity.

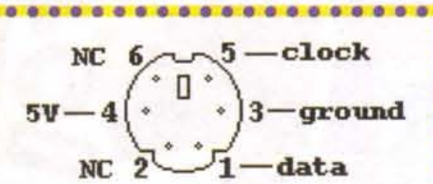


FIGURE 1. MOUSE CONNECTOR

Part 2 will use the interface to implement a mouse + LCD menu capability for Parallax's BASIC Stamp. The third and final article in this series will show how programming modifications alone provide a PS/2 keyboard interface for use with a BASIC Stamp.

Connector

The mouse plugs into a six-pin mini DIN connector. Four of the possible six connections are used. Figure 1 shows the socket's numbering scheme as viewed from the plug insertion aspect.

Data Line

At the physical layer, the data line is an open drain interface. In other words, the line defaults to an open, 5V high unless driven low. The host or the mouse may drive this line low. A logical 1 is represented by 5V, while 0V signifies a logical 0. The SX28 host drives the line low by setting rb.0 — the connection to the clock line — to the output, low state. To release the line so it may assume a high state, rb.0 is set to input and the SX28's programmable, internal pull-up resistor for rb.0 is enabled. During data transmissions, the data line is sampled during low clock pulses.

Clock Line

The active-low clock line duplicates the open drain physical configuration of the data line. Again, the host or the mouse may drive this line low, as described later. For now, remember that the mouse supplies the clock pulses for data transmissions in both directions, while the host drives the clock line low only to inhibit mouse transmissions. Mouse clocking cycles may vary from approximately 50 microseconds (μsec) to 150 μsec.

Data Exchange

All data exchanges between the host and the mouse occur as synchronous serial transmissions. A logical transmission unit consists of a low start bit, an eight-bit byte transmitted least significant bit first, an odd parity bit, and a high stop bit. Taken together, these 11 bits are often referred to as a serial data unit (SDU). A logical grouping of SDUs sent one after another is called a data packet. Transmissions from the host to the mouse are always commands. The mouse may transmit command acknowledgements, status information, or operational data.

Host-to-Mouse Transmission

Commands to the mouse should only be initiated when the interface is idle, i.e., when clock and data are released (high). To begin transmitting an SDU, the host seizes control of the interface by driving the clock line low for ~200 μsec to inhibit mouse transmissions. At the end of this period, the data line is driven low and the clock line is released. The mouse interprets this configuration as a start bit. The mouse will shortly drive the clock line low, which is a signal to the host to present the low order data bit value to the data line. After sampling the data line, the mouse releases the clock back to a high state.

This process is repeated seven more times as the host presents successively higher order data bits in response to the low clock pulses. A ninth clock pulse from the mouse signals the host to provide the parity bit value, and a 10th clock pulse prompts the host for the stop bit. Finally, the mouse pulls the data line low and generates an additional clock pulse to acknowledge receipt of the SDU. The interface is then returned to the idle condition.

Following receipt and execution of a host command, the mouse will typically transmit an acknowledgement SDU back to the host. However, the set loopback mode and repeat last data packet commands are not acknowledged in this manner. Invalid commands result in a nack SDU returned by the mouse.

Mouse-to-Host Transmission

The mouse will not initiate SDU transmissions unless the interface is idle. To begin transmission, the mouse drives the data line low and pulses the clock low, which the host must recognize as a start bit. Eight succeeding low clock pulses then signify the presence of data bits to be sampled. A 10th pulse accompanies the parity bit, and a final low pulse indicates the stop

bit is on the data line. The host has the parity and stop bits at its disposal to verify the SDU's integrity.

Mouse Functional Modes

In normal operation, your mouse accumulates displacement information over an interval of time. When the interval expires, the mouse transmits a summary of movement during the reporting interval along with the then-current status of the mouse buttons. Displacement is tracked and reported in terms of x axis and y axis counts, which have a direct relationship to millimeters (mm) moved left or right (x axis) and forward or backward (y axis).

Movement to the operator's left is reported as negative x displacement, and movement toward the operator as negative y displacement. Accumulated movement during a reporting interval that results in a return to the same location occupied at the beginning of the interval is reported as zero displacement. Similarly, a complete button press and release cycle that takes place after the start and before the end of a reporting interval is invisible in data reported to the host.

The reporting interval depends on several factors, the most important of which is the mouse's operational mode. In stream mode, the interval begins upon mouse movement or button press/release, and ends 1/200 to 1/10 second later (determined by set rate command).

This is the usual operational mode for a mouse used with a personal computer, and the default mode upon power application to the mouse (stream mode transmissions must also be enabled for data packets to actually be sent). In remote mode, a new interval begins after the previous interval's data packet was transmitted, and ends only when the host requests a subsequent data packet.

A third loopback mode — often referred to as wrap mode — is available for testing purposes. When placed in this mode, the mouse simply echoes any SDU it receives back to the host, excluding the send status and reset loopback mode commands.

Mouse Commands

The interface implements 16 standard PS/2 mouse commands. The command identifiers and sequences are fully documented in the program code and not repeated here.

Data Packets

An understanding of the status and operational data packets allows effective use of the interface. See the program source code for a quick summary of the packet formats.

The mouse transmits a three-byte status data packet in response to a send status command. The packet contains the current button status, as well as operational mode status, resolution, and sample rate. The resolution (counts/mm) and scaling factor (1:1 or 2:1) together determine how many counts are reported for each mm of mouse displacement in the operational data packets. The sample rate determines the duration of the reporting interval when in stream mode.

Once the mouse is configured to the desired operating mode and parameters, most

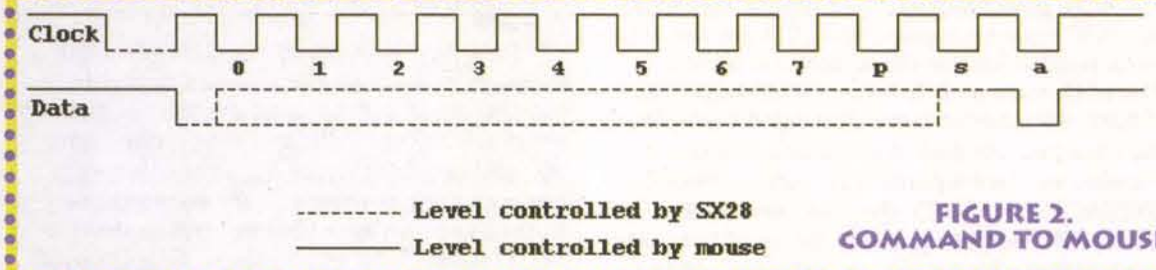


FIGURE 2.
COMMAND TO MOUSE

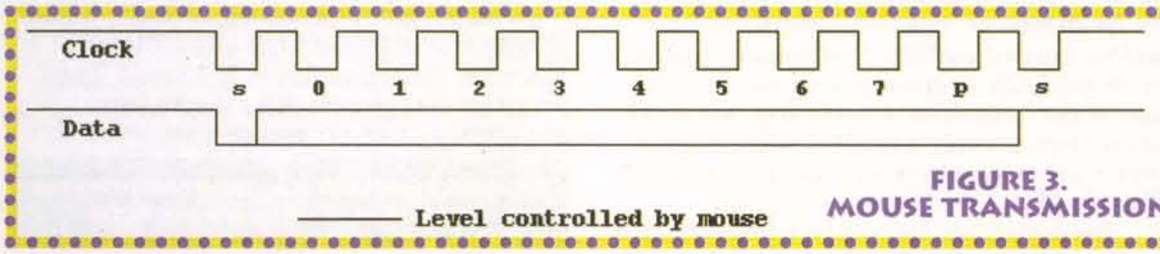


FIGURE 3.
MOUSE TRANSMISSION

Metric
Equipment Sales, Inc.
800-432-3424
Fax: 510-264-0886
www.metricsales.com

RENT • BUY • SELL
Yes, we will buy your surplus equipment!

Scopes, Meters, Analyzers, Power Supplies, Signal Generators, Counters, Recorders and more

Hewlett-Packard, Tektronix, Fluke, Dranetz, TTC, Anritsu, Wavetek, Keithley, and more

Test & Measurement Instruments
Over 7000 Models • 6-Month Warranty
Save 30-90% • 5-Day Free Trial

Write in 147 on Reader Service Card.

ALLTECH ELECTRONICS
WWW.COMPUTERCHOPPER.COM
WE CHOP PRICE$!

SCSI CDROM
Matsushita / Apple OEM PC or Mac SCSI
4x $19 24x $79

486 Mini System
486SX25 • Great for Linux DX266 Upgradable • 2 ISA Slots • VGA, LPT, 2COMs • FD
$29

250VA Isolation
Transformer
115V Pri - 115V 250VA Sec
Magnetek Triad
6" x 4" x 5"

10"Open Frame SVGA
Metal Enclosed - Displays Up to 1024 x 768 • 110V AC
Also Available in a standard case. $129
$119

7 SCSI CD's in a Tower
7 CR-504-L Drives in a SCSI Tower case - 50 Pin
$179

Open Frame
Industrial DC P/S
+5/12 -5/12 +24V
$29

24 Bit Flat Bed Scanner
Win95/98 - ImageWave by Storm Technology. Parallel Port Interface Software Included!
5 Minute Installation
$39

LCD Closeout!
Various LCD's - In New Condition - We have no Docs or controllers. See the web. Starting at
$29

9" Mono VGA
Small footprint monitor
Great for servers, test benches, etc. 640 x 480 only. Refurbished.
$49

9.75" Mono, 8.6" and 10.4" Color LCDs
Great for Servers:
ISA Controller Included!!
All screens are 640x480. The controller supports 256 Colors.
9.75" Mono Passive......$89.00
9.5" Color Passive.......$199.00
10.4" Color Active.......$319.00
Touch Screen Option Available.
See our web site for more details.
$89 & up.

Cheaper Ethernet Stuff
Industrial Surplus
PC Parts • Mac Parts
For more information on these products and hundreds of other products check out:
www.ComputerChopper.Com

760/724-2404
Fax 760/724-8808
Computer Circulation Center, Inc.
2618 Temple Heights Drive
Oceanside, CA 92056

Mon-Fri 9AM -5:30PM - Or see us on the internet.
VISA • Mastercard • Discover • American Express
Prices & Availability subject to change without notice • Government & Educational PO's Accepted. • Not Responsible for Typographical Errors

Write in 146 on Reader Service Card.

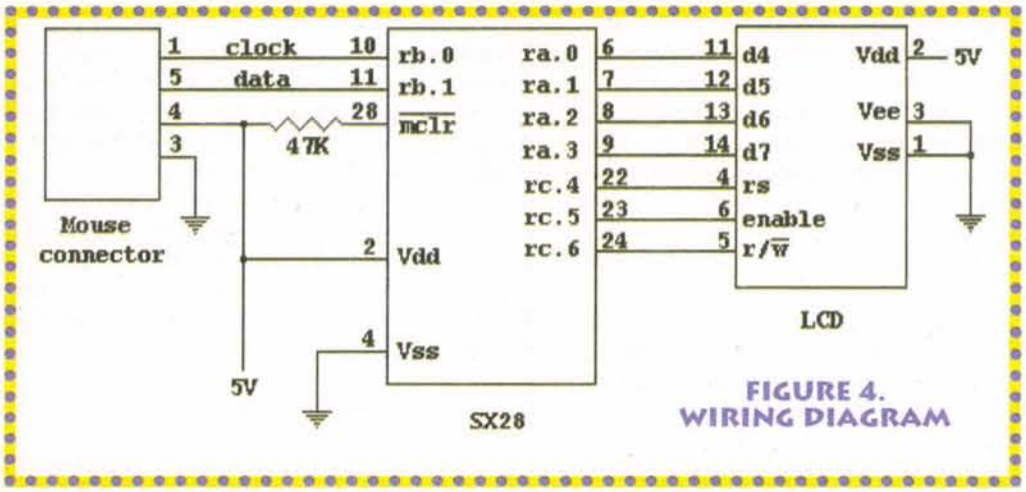


FIGURE 4. WIRING DIAGRAM

activity revolves around the three-byte operational data packets. These packets are transmitted at the end of the reporting interval and contain the real meat of the mouse repast. The packet's first byte tells you if either button is pressed, and how to interpret the displacements indicated in the second and third bytes.

If bit 7 is set, the absolute value of the y axis displacement count exceeded 255, which is hard to do unless the reporting interval's duration is overly long.

Bit 6 reflects the same condition for the x axis displacement count. If bit 5 is set, the y axis displacement count in the packet's third byte is a twos-complement negative number.

Similarly, if bit 4 is set, the x axis count in the packet's second byte is a negative value. If the right or left mouse buttons were depressed when the packet was assembled, bits 1 or 0, respectively, will be set. The second and third bytes in the packet contain the interval's x and y displacement values.

Construction

A 5V power supply, PS/2 mouse and socket, SX28 microprocessor, and LCD are the only parts needed for this demonstration project. The LCD, such as B G Micro's 4x20 LCD1002 ($5.95, www.bgmicro.com/) is used to display the data packets and other mouse responses. Parallax Inc. (www.parallaxinc.com/) offers the SX28AC/DP for $4.25, the free, feature-filled SXKey28L assembler, and a choice of hardware programmers for the SX. Because precise timing is not critical for this demonstration project, the SX28 runs on its 4 MHz internal oscillator and no external oscillator/resonator is needed. Since the SX28's internal pull-up resistors take care of the open drain requirements, the entire project requires only a single discrete component — a 47K resistor from SX28 pin (master reset) to 5V.

The project can be built on a breadboard, if desired (the LCD 1002 header pins slip nicely onto a breadboard for quick prototyping). Connect the SX28, mouse, and LCD as shown in Figure 4. **NV**

DEMONSTRATION PROGRAM

The program configures the SX28 to use its internal 4 MHz oscillator. Program variables, equates, and macros are then declared and designed to maximize flexibility and readability. An initialization routine clears variable memory and prepares the LCD display. Subroutines occupy the low program memory locations due to typical first-half-page subroutine calling constraints.

Program execution consists of running through all mouse commands and displaying the results. A loop at the end of the program accepts stream mode data packets and displays more intuitive interpretations of their contents — try moving the mouse around and clicking the buttons to see the interface at work and how it could serve in your project.

The program's comments and modular structure should ease translation to an alternate microprocessor, if desired. The program was successfully tested with Logitech, Microsoft, and generic mice.

You can download this program from our website at www.nutsvolts.com

Newsbytes

Continued from page 16

Capture Web Sites, playing with DISCo Pump

Arsenal has released DISCo Pump version 3.1, a powerful and easy-to-use web site capture and offline browser program for Windows 98/95/NT4. DISCo Pump lets you conveniently save all or part of the Internet sites that you visit, and rebuilds the links on your local drive so you can browse them offline, without being connected to the Internet. DISCo Pump saves money because its offline browser lets you view important web screens without being connected to the Internet, avoiding connect time charges. Because DISCo Pump downloads sites faster than most off-line browsers, it saves you valuable time.

Users can interact with DISCo Pump as it is pumping data from the Internet. As the downloading begins, DISCo Pump tells you which pages have been read, which are waiting to be read, which were saved in previous download sessions, and which were excluded from the process by the user. You determine from how many levels into a web site you want the program to pump data, and which pages you want to ignore.

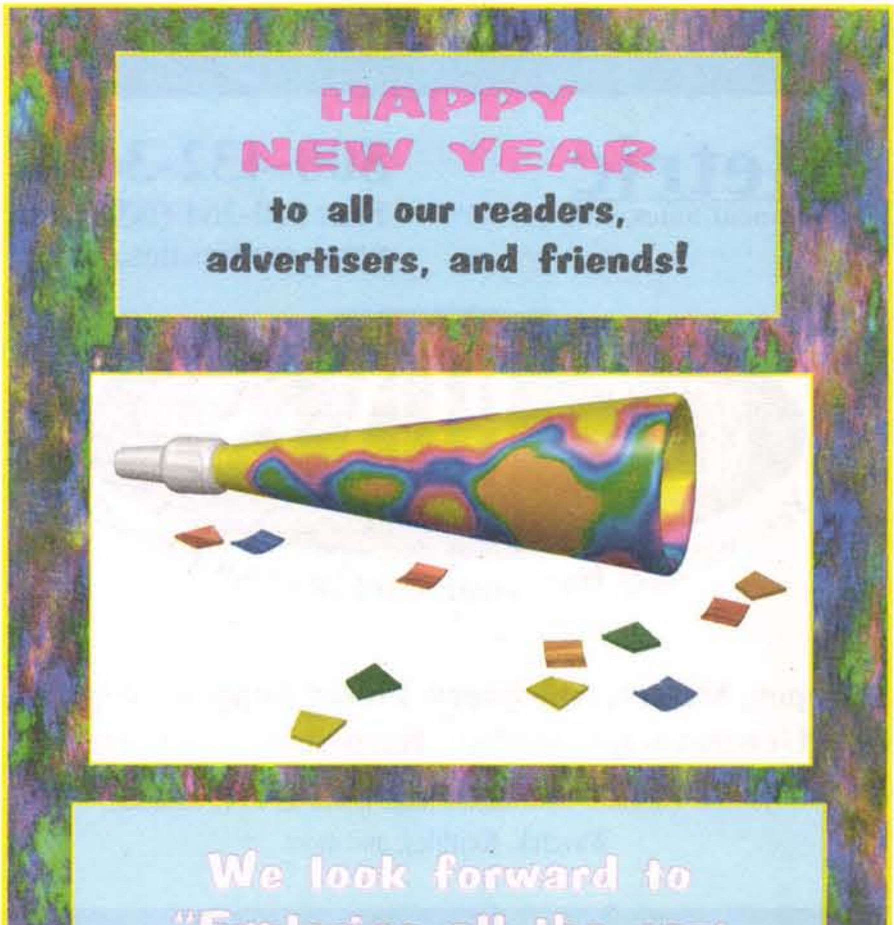
Using the Explorer-style file tree interface, you can just while pumping specify which branches to expand, and which to ignore. Broken Internet connections are detected and corrected, and DISCo Pump restarts the download process at the point where the interruption occurred.

In addition to the file tree interface, you can use DISCo Pump's navigation map and approach the captured web site by viewing the hierarchical structure of the downloaded documents. With either view, DISCo Pump offers draft preview of any downloaded pages. Thus you can navigate the entire downloaded site, quickly and easily.

DISCo Pump version 3.1 costs $29.95(US). You can download a trial version of DISCo Pump or purchase it online from

http://www.disco-software.com/pump.htm

E-Mail: arsenal@ars.ru



New Product News

NEW COMPONENTS CATALOG

Jameco Electronics announces the release of their latest catalog 994 "Your Component Path to the New Millennium."

The free 150-page catalog features thousands of ICs, components, tools, test equipment, and computer products for OEMs, engineers, educators, and service/repair technicians.

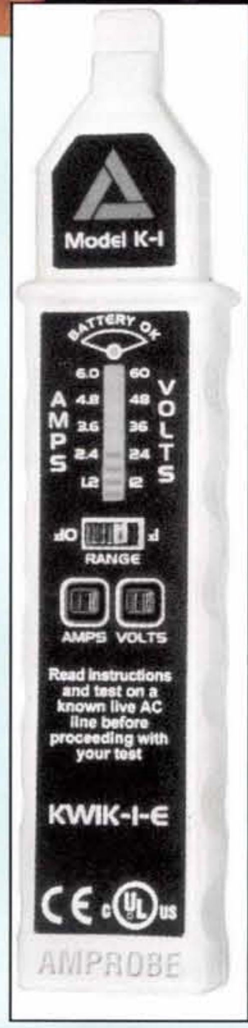
More than 190 new products have been added including a new line of power supplies and converters by Volgen and Atmel ICs.

Jameco has also expanded their lines of data acquisition products by ComputerBoards, motors, USB products, Parallax basic controllers, SX chips, and much more.

Log on to www.jameco.com and check out the on-line catalog and Virtual Spec Room. Jameco features product photos, expanded descriptions, and a user-friendly ordering process from a secure web server. Look for new and special product offers and helpful tech tips.

For more information, contact:

JAMECO ELECTRONIC COMPONENTS
1355 SHOREWAY RD., DEPT. NV
BELMONT, CA 94002
650-592-8097 FAX: 650-592-2503
E-MAIL: info@jameco.com
WEB: http://www.jameco.com



KWIK-I-E® PROBE

Until now, electricians and HVAC technicians needed to strip, pierce, or find exposed conductors to obtain correct volt or current measurements.

Amprobe's innovative KWIK-I-E® "non-contact" volt and current probe measures AC voltages and AC amps without touching a bare conductor. It obtains an instantaneous reading and by detecting electro magnetic and electro static fields.

Amprobe's KWIK-I-E accommodates a wide range of wire sizes for accurate indications. It is not only fast and accurate, but versatile. It easily detects the "HOT" side of AC lines.

Its easy push-button operation makes KWIK-I-E user-friendly. The 10-light bargraph display is simple to read. Specs on Amprobe's KWIK-I-E include: AC current levels of 0.6 to 60 amps (60 Hz); AC voltage levels of 6 to 600 volts (60 Hz).

For more information, contact:

AMPROBE®
630 MERRICK RD., P.O. BOX 329, DEPT. NV
LYNBROOK, NY 11563
516-593-5600
FAX: 516-593-5682

TALK-N-TELL™

National Systems, Inc. announces its latest audio recorder and player. Dubbed the model MR460 Talk-N-Tell™ digital message repeater, the unit will record an audio message into electronic memory (no magnetic tape) up to 60 seconds long.

The unit is self-contained within the loudspeaker housing and may be triggered by a variety of external switches.

Purchasers of the unit will record their own messages into non-volatile memory (no backup battery required), saving production costs and installation delays.

National Systems, Inc. also offers both mechanical and infrared push buttons, as well as infrared motion sensors to trigger the unit to play the message.

Customers may also use their own device to trigger the unit, the internal circuit only requires a switch closure or an open collector transistor to start the unit playing. The audio output volume is adjustable with a maximum of 10 watts of output power.

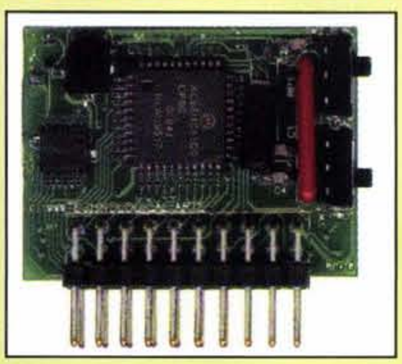
The basic cost is under $300.00 and is available from stock.

For more information, contact:

NATIONAL SYSTEMS, INC.
13 HAMMATT ST., STE. 150, DEPT. NV
IPSWICH, MA 01938
978-356-1011 FAX: 978-356-0091

Showcase your New Products here! Send all press releases or information/photos to:

Nuts & Volts Magazine
New Product News
430 Princeland Court,
Corona, CA 92879
or E-Mail to
newproducts@nutsvolts.com



MICROSTAMP 11

Technological Arts has launched the first product of a new family, dubbed MicroStamp11. Billed as the world's smallest commercially available 68HC11 microcontroller module, MicroStamp11 brings the power and flexibility of Motorola's 68HC11 – one of the most widely used eight-bit microcontroller chips – to a whole new range of applications.

Utilizing a 68HC11(E)D0 operating in expanded mode, MicroStamp11 offers a rich set of hardware features including three input captures, four output compares, pulse accumulator, real-time interrupt, serial communications interface (SCI), serial peripheral interface (SPI) watchdog timer, 25 programmable interrupts, and up to 512 bytes of RAM.

Boasting 14 multi-purpose programmable input/output lines and two hardware interrupts pins, MicroStamp11 is particularly well-equipped for multitasking in real-time control and monitoring applications.

Measuring only 1.0 by 1.4 inches, Microstamp11 is available with a choice of 8K or 32K of in-circuit programmable EEPROM, and comes complete with on-board 5-volt regulator and low-voltage inhibit reset circuit.

Thanks to the 68HC11s well-engineered architecture and instruction set, MicroStamp11 can easily be programmed in all of the popular embedded control languages, including Assembler, C, BASIC, and Forth.

With a single-piece price of only US $34.00 (with 8K EEPROM), and US $45.00 (with 32K EEPROM), MicroStamp11 is ideal for a broad spectrum of applications requiring a compact low-cost 68HC11 core.

Loading code into MicroStamp11's EEPROM is made easy, thanks to a low-cost docking module, which provides a reset button, indicator lights, and an RS232 interface, to take advantage of the 68HC11's special bootstrap mode.

Technological Arts offers a starter package, which includes one MicroStamp11 module, docking module, serial cable, documentation, and a disk of DOS utilities and sample code.

A starter package for the 8K MicroStamp11 (MS11SP8K) is available for US $49.00, while a 32K version (MS11SP32K) is available for US $60.00.

For more information, contact:

TECHNOLOGICAL ARTS
26 SCOLLARD ST., DEPT. NV
TORONTO, ONTARIO
CANADA M5R 1E9
416-963-8996 FAX: 416-963-9179
E-MAIL: sales@technologicalarts.com
WEB: http://www.technologicalarts.com

www.web-tronics.com www.web-tronics.com www.web-tronics.com

High Performance Auto Ranging DMM

New to our DMM line-up and possibly (probably) the best DMM value anywhere! Includes: Analog Bar Graph! Auto-Ranging! Data Hold! Temperature Probe! Frequency Test! Continuity Test! AND MORE!

ONLY $29.95

Available Late December 1999.

Features
Data Hold: Freezes reading for easy checking
Auto Ranging: For easy, precise range settings
Range Hold Control: allows for manual selection of your test range
3-3/4 Digit LCD Display: Reads up to 3260. Easy to read display
Function Dial: Easy to use to select measurement type or turn unit off.
4 Jack Plug-ins: Safety design with different capacities for different functions.
Diode, Continuity Check Push-Button: For toggling between diode check and continuity check.
Low Battery Indicator: Advises you when it's time to change battery.
Extra Long 44" Test Leads: Helps get to hard to reach places
Screw-On Alligator Clips: Convert one or both probe tips to alligator clips.
Fuse-Protected Circuitry
Built-In Stand: Makes one hand operation easier.
Shock Absorbing Rubber Carrying Case: with convenient probe storage clips and hanging tab. Helps protect the DMM from damage if accidentally dropped.

Measures:
DC Volts: up to 1000V
AC Volts: up to 750V
AMPS: up to 20 Amps (AC & DC)
Resistance: up to 30M ohm
Continuity Check: with audible signal (signal sounds if resistance is less than 20 ohms. Display reads actual resistance).
Frequency: (1KHz to 300KHz) displays both digital and bar graph reading
Transistor hfe Test: Display shows approximate hfe value based on test condition of 10uA base current and Vce of approx. 3V.
Temperature Test: Measures from 0° to 1832° F (probe supplied!)
Diode Test: Tests if diodes are shorted or open

Specifications
Accuracy

Vdc:	±1.0% reading +5 ditis
Vac:	±1.5% reading +8 digits
Adc:	±1.2% reading +5 digits
Aac:	±1.5% reading +5 digits
Resistance:	±1.5% reading +5 digits
Frequency:	±3.0% reading +5 digits
Temperature:	±1.0% reading +6 digits

Input Impedance: 10Mohm (Vdc/Vac): over 100Mohm on 300 mVdc range
Requires two AAA batteries sold separately.

#CSI9903

2GHz RF Field Strength Analyzer

ONLY $1589

- Frequency Range: 100KHz to 2,060MHz
- Narrow Band FM (NFM), Wide Band FM (WFM), AM and Single Side Band (SSB) Modulated Signals May Be Measured
- PLL Tuning System for Precise Frequency Measurement and Tuning
- LED Backlight LCD (192x192 dots)
- Built-In Frequency Counter
- Hand-Held and Battery Operated
- All Functions are Menu Selected
- RS232C for PC Interface and Printer

#3201

See the web site for details

Removable Hard Drive Rack
For IDE/Ultra DMA Hard Drives

We Sold Over 14,000 in 1998!

ONLY $14.95 any qty.

This product can be used with any 3-1/2 IDE hard drive up to 1" high. It includes an electronic keylock for safe removal and insertion. Made of ABS 707 fireproof plastic. Use this product to protect sensitive hard drive data, take your hard drive between work and home or even set up different users with their own hard drives that they physically insert every time they use a PC. Other models available from C.S.I. include RH10 series and RH20 series, which are interchangeable within the same interface design (IDE or SCSI).

RH-10C-IDE

Other Models are Available. *See www.web-tronics.com under "hard drive and accessories" for more details and pictures.*

Removable Hard Drive Rack with Auto Door And Cooling Fan

ONLY $18.95 any qty.

- Auto door on the outer frame
- ABS material of outer frame, High efficiency cooling fan
- Worldwide patent pulling function handle
- CE Approved
- Coating iron bottom cover
- For IDE interface
- For 1" high 3.5" HDD
- Not compatible with our RH10 & RH20 series. Compatible with our RH17-IDE model.

#MR-27

Details at www.web-tronics.com

Auto-Temp Solder Station with Ceramic Element

ONLY $39

- With Ceramic Heating Element for More Accurate Temp Adjustment
- 3 Conductor Grounded Power Cord
- 250°C-480°C (470°F-900°F)
- Fast Heating Feature

SR-976

Extra Tip Options Available. See Web!

For More Info See www.web-tronics.com

CTRL - D to bookmark this site

www.web-tronics.com

Don't forget the dash

- Easy to Navigate
- Includes a Search Engine That Really Works
- New Items Added Constantly

Circuit Specialists Inc.

In Business Since 1971

Mini CCDs (B/W & Color)
Sensational NEW Design for Small Observation Cameras. *Smaller and Better!*

- ***Ultra Miniature Design***
- ***Black & White Versions Only 25mm x 25mm***
- ***Color Versions Only 32mm x 32mm***
- ***Available in Standard Lens or Pinhole Lens***
- ***All Include Audio***
- ***All Include Pre-Wired Cable Harness for Audio, Video & Power***
- ***12V Regulated Power Supply Required (120mA typical power consumption)***
- ***0.1 LUX Rating (B/W), 1 LUX (color)***
- ***CCD Area Image Sensor for Long Camera Life***
- ***Back Light Compensation Circuit***
- ***Built-In Electronic Auto Iris Lens***

Detailed Specs on the Web

VMCW-H11A 32mmx32mmx30mm, Color CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power $149.00 / $139.00 5 or more
VMCW-H12A 32mmx32mmx19mm, Color CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input $149.00 / $139.00 5 or more
VMPS-718A 25mmx25mmx30mm, B/W CCD with standard lens, pre-wired cabling for video/audio, 12V DC Power Input $69.00 / $59.00 5 or more
VMPS-250A 25mmx25mmx15mm, B/W CCD with pinhole lens, pre-wired cabling for video/audio, 12V DC Power Input $69.00 / $59.00 5 or more

CCD B&W Board Cameras

- ***ASIC CCD Area Image Sensor***
- ***Extremely Low Power Consumption***
- ***0.5 Lux Min Illumination***
- ***Built-In Electronic Auto Iris for Auto Light Compensation***

Detailed Specs on the Web

VM1030PA-B 30mmx30mmx25mm, Pinhole lens with audio, 12V $49.00 any qty.
VM1030A 30mmx30mmx26mm, Standard lens with audio, 12V $49.00 any qty.
VM1035A 42mmx42mmx25mm, Standard lens with audio, 12V with back light compensation $59.00 any qty.
VMCB21 44mmx38.5mmx28mm, with 6 infra-red LEDs, 12V $49.00 any qty.
VM1036A 32mmx32mmx25mm, Standard lens with audio, 12V, reverse mirror image feature $59.00 any qty.

Bullet CCD Cameras
B&W and Color

Detailed Specs on the Web

- ***Smart Rugged Metal Housing***
- ***Extrememly Low Power Consumption***
- ***12 Volt***
- ***CCD Area Image Sensor for Long Camera Life***
- ***Built-In Electronic Auto Iris for Auto Light Compensation***
- ***No Blooming, No Burning***
- ***0.1 Min Lux Illumination (B&W), 1 Lux Min Lux Illumination (color)***

VMBLT1020 B&W, 21mm(D)x55mm(L) $59.00 any qty.
VMBLT1020W B&W Weatherproof (no audio), 21mm(D)x58.5mm(L) $79.00 any qty.
VMBLT1020A B&W with audio, 21mm(D)x55mm(L) $69.00 any qty.
VMBLTJC19BW COLOR! Weatherproof (no audio), 17mm(D)x88mm(L) $139.00 any qty.

COLOR CCD Mini Board Cameras

- ***Low Power Consumption***
- ***1 Lux Illumination***
- ***Built-In Electronic Auto Iris for Auto Light Compensation***
- ***Internal Synchronization***
- ***12Volts***
- ***400 TV Lines***

Detailed Specs on the Web

VM3010PA 33mmx33mmx18mm, Pinhole lens with audio $129.00 any qty.
VM3011-A 45mmx40mmx24mm, Standard lens with audio, single board $99.00 any qty.
VM3010-A 33mmx33mmx32mm, Standard lens with audio $129.00 any qty.

new! Hot Air SMD Rework Station

WOW! ONLY $489
Similar Systems Cost 100s More!

ONLY $489

#SR-979

For technicians, service/repair depots and assembly rework. We also stock a selection of nozzles for QFP, SOP & PLCC devices (see our website for selection details). Hot Air temperature variable from 100°C to 400°C (212°F to 754°F) power consumption: 275w max. Auto cooling feature cools system after shut off to extend service life of heating elements and handle. One year limited warranty from C.S.I.
Comes with QFP Nozzle (0.68" x 0.68")

new! O'Scope Offer

30MHz! ONLY $289!
Take Advantage of this low introductory price!

ONLY $289

- *Dual Channel*
- *Dual Trace*
- *Vert Trigger*
- *1 Year C.S.I. Warranty!*

#OSC-1030

Manufactured for CSI by a leading O.E.M. manufacturer. See our website for detailed specifications!

new! 2.4 GHz A/V Sender/ Receiver System

- **Wireless FM transmission of video (color or B/W) and sound (stereo or mono) up to 150 meters (line of sight)**
- **Directional Antenna Design optimizes performance**
- **Use with remote cameras or any input (satellite TV, cable etc.) where wireless transmission is desired. View on a TV set.**
- **Performance through walls varies depending on construction methods etc.**
- **Each set includes a plug-in power supply for the transmitter & receiver.**
- **7 segment LED displays channel (1-4) on receiver & transmitter.**

CSIHTR2400 *Includes One Transmitter & One Receiver with Power Supplies* $139.00
CSIHTR2400TX *Extra Transmitter/Each Receiver will Monitor up to 4 Transmitters* $89.00

See more detailed specifications at www.web-tronics.com in the CCD camera setcion.

new! 3-1/2 Digit JUMBO Digital Panel Meters Check these LOW PRICES!

Available End Of December 1999

AS LOW AS $6.25

- 21mm Figure Height
- 5 Volt Common Ground or 9V Independent Power Supply Versions Available
- Voltage Divider Resistors included and max. Measured Range Selectable by Soldering a Selection Joint
- Easy Bezel Snap-In Design (84mm x 41mm rectangular hole typical)
- "0" Reading for "0" Voltage Input
- High Quality SMD Production Method
- Dual Slope Integration A-D Converter System ±0.5% Accuracy

PM-1028A *LCD* **9V Independent Power Supply Version 1/**$12.95 **10/**$10.89 **100/**$7.99 **250/**$6.25
PM-1028B *LCD* **5V Common Ground Power Supply Version 1/**$13.95 **10/**$11.84 **100/**$8.89 **250/**$7.15
PM-1029A *LED* **9V Independent Power Supply Version 1/**$14.95 **10/**$12.50 **100/**$9.95 **250/**$7.89
PM-1029B *LED* **5V Common Ground Power Supply Version 1/**$15.95 **10/**$13.40 **100/**$10.79 **250/**$8.65

3000 Series Digital R/O Bench Power Supplies

♦Low Cost Single Output ♦High Performance Triple Output

AS LOW AS $89

High stability digital read-out bench power supplies featuring constant voltage and current outputs. Short-circuit protection and current limiting protection is provided. The dual output versions can be used in both serial voltage and parallel current configurations to double maximum outputs. Highly accurate LED accuracy and stable line regulation make the 3000 series the perfect choice for lab and educational use.

Line Regulation: 2×10^{-4} +1ma
LED Accuracy: Voltage ±1% +2 digits
Current ±1.5% +2 digits
Wave Line Noise: ≤1mvrms
Dimensions: 291mm x 158mm x 136mm (CSI3003 & CSI3010)
365mm x 265mm x 164mm (CSI3003-3 & 3005-53)

CSI3003: 0-30v/0-3amp Digital R/O Bench PS, 1×10^{-4}+5mv Load Regulation	$99.00 5/$89.00
CSI3010: 0-30v/0-10amp Digital R/O Bench PS, 1×10^{-4}+30mv Load Regulation	$149.00 5/$139.00
CSI3003-3: Triple Output 2x(0-30v/0-3amp)+5v, 3amp Fixed, 1×10^{-4}+5mv Load Regulation	$239.00 5/$219.00
CSI3005-3: Triple Output, 2x(0-30v/0-5amp) +5v, 3amp Fixed, 1×10^{-4}+25mv Load Regulation	$269.00 5/$249.00

Our Most Sophisticated DMM *We Sold Over 700 Last Year!*

with RS-232 Interface & Software, 3-3/4 Digit, 4000 Count, Auto-Ranging with Analog Bargraph

- True RMS Mode
- 10MHz Frequency Counter
- Time Mode with Alarm, Clock, and Stop Watch
- Dual Display
- 10 Location Memory
- Min, Max, Avg and Relative Mode
- Decibel Measurement
- Cap and Ind. Measurement
- Temperature Mode (C/F)
- K Type Temperature Probe Included
- Pulse Signal for Logic & Audible Test
- Continuity/Diode Test
- Logic Test
- Auto Power OFF/"Keep ON" Mode
- Fused 20A Input with Warning Beeper
- Back Light
- Data Hold/Run Mode
- Safety Design UL1244 & VDE-0411
- Protective Holster
- Silicon Test Leads

NOW ONLY $129
Reg. $169

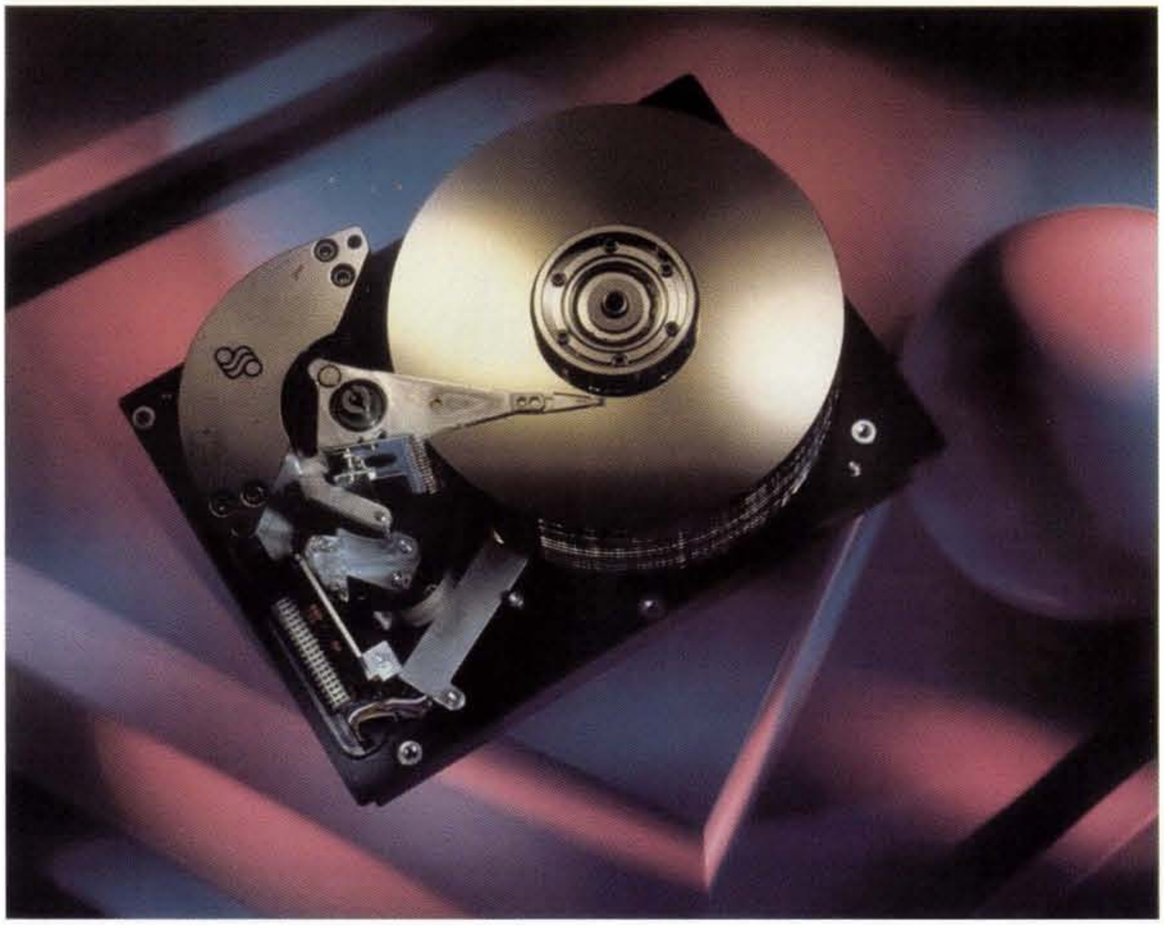
More Details on our Web Site

PROTEK 506

CIRCUIT SPECIALISTS, INC. 220 S. Country Club Dr., Mesa, AZ 85210 800-528-1417/480-464-2485/FAX: 480-464-5824

Write in 63 on Reader Service Card.

MONSTER
47GB SCSI DRIVE



$695

FREE SCSI ENCLOSURE

408 330-5523

Open Windows instantly. Process huge graphic and database files with ease. Make your file server scream with speed.

The 47GB Seagate Elite is the drive you need for serious performance. It features 14 disks and 28 heads for blazing performance 3.5" drives can't touch. The Ultra Wide interface makes installation a snap. A 4MB cache buffer accelerates data transfers.

A special volume purchase brings you brand new drives at low, low PC prices. Shop around. Compare price. No one else can match this deal.

Buy just one drive and build the ultimate workstation. Or add several to take advantage of NT RAID performance. Let us custom-build your multi-drive disk array at no extra charge. Redundant rack-mount trays stack to build arrays bigger than 1,000GB per rack!

Get the speed you need and the reliability you deserve. Get rock solid Seagate quality backed by a warranty of up to six years! Call now! Try your 47GB monster drive risk-free.

CORPORATE SYSTEMS CENTER
3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.SCSIDRIVES.COM

Seagate ST446452W drives are PC, Mac, SGI, and Sun compatible. 5 1/4" Elite drives are sold only in OEM enclosures and disk array trays. CSC carries low-cost, top-quality PCI controllers and SCSI accessories. If you haven't already upgraded to SCSI, call us for help. No-risk guarantee refunds your entire purchase price (less shipping) if you're not completely satisfied within 15 days. Call for your free catalog of hard drives, duplication equipment, and accessories.

Write in 66 on Reader Service Card.

Write in 194 on Reader Service Card.

NUTS & VOLTS MAGAZINE
430 PRINCELAND COURT
CORONA, CA 92879-1300